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ABSTRACT

Presented are seven folios of energy activities for elementary school students. Each set is devoted to different energy-related themes: (1) What is energy? What does energy do? Where does energy come from?; (2) We find energy in many places; (3) Energy does all the work in the world; (4) The Earth's energy sources are limited; (5) Energy changes from one form to another; (6) The energy situation affects Minnesotans today; and (7) The energy situation will affect the future. The folios, separated by age levels, contain a total of 60 cards with three learning activities per card. The photograph or drawing that illustrates each card serves to focus attention and stimulate discussion about the activities. (MB)

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ED200445

Minnesota Energy Activities

For Elementary Students

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

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SE 034 548

LEVEL A for Ages 4-6

WHAT IS ENERGY? WHAT DOES ENERGY DO? WHERE DOES ENERGY COME FROM?

1. Energy is the "go" of things.
2. Our bodies need energy. Energy comes from the food we eat.
3. Energy moves things. The energy to move things comes from many sources.
4. Energy lights things. There are many sources of light.
5. Energy heats things. There are many sources of heat.

LEVEL B for Ages 5-7

WE FIND ENERGY IN MANY PLACES

1. We get energy from the sun.
2. We get energy from the wind.
3. We get energy from water.
4. We get energy from wood, coal, oil, and gas.
5. We use the energy of electricity.

LEVEL C for Ages 6-8

ENERGY DOES ALL THE WORK IN THE WORLD

1-2. Work happens when something moves or changes.
3-4. Energy has to be put into a machine before we can get work out of it.
5-6. People invent machines to do work.
7-8. There are more machines now than in the past.
9. Some of the machines we use today are more important to us than others.
10. In some countries people use fewer machines and less energy than we do.

LEVEL D for Ages 7-9

THE EARTH'S ENERGY SOURCES ARE LIMITED

1-2. Major energy sources in use today are unevenly distributed around the world and must be transported to where they are needed.
3-4. Energy sources are either renewable or nonrenewable.
5-6. Cutting consumption is a way to conserve energy.
7-8. Insulating is a way to conserve energy.
9-10. Recycling is a way to conserve energy.

LEVEL E for Ages 8-10

ENERGY CHANGES FROM ONE FORM TO ANOTHER

1-2. Energy is either waiting (potential energy) or it is working (kinetic energy).
3-4. We use some forms of energy without changing them.
5-6. Energy can be changed (converted) from one form to another to make it more useful.
7-8. There are natural and technological conversion systems.
9-10. Energy is wasted in conversion.

LEVEL F for Ages 9-11

THE ENERGY SITUATION AFFECTS MINNESOTANS TODAY

1-2. Minnesota has special energy problems.
3-4. The cost of energy has an economic impact on families.
5-6. Jobs are dependent on energy availability.
7-8. Energy use has environmental consequences.
9-10. Conservation is everybody's business.

LEVEL G for Ages 10-13

THE ENERGY SITUATION WILL AFFECT THE FUTURE

1-2. Because Minnesota's energy resources are limited, we need to look at alternative sources.
3-4. Alternative energy sources continue to be developed.
5-6. By making use of wastes, we conserve energy.
7-8. The energy situation has an international impact.
9-10. Further advances in energy-related technology will have an impact on our lives that is difficult to imagine.

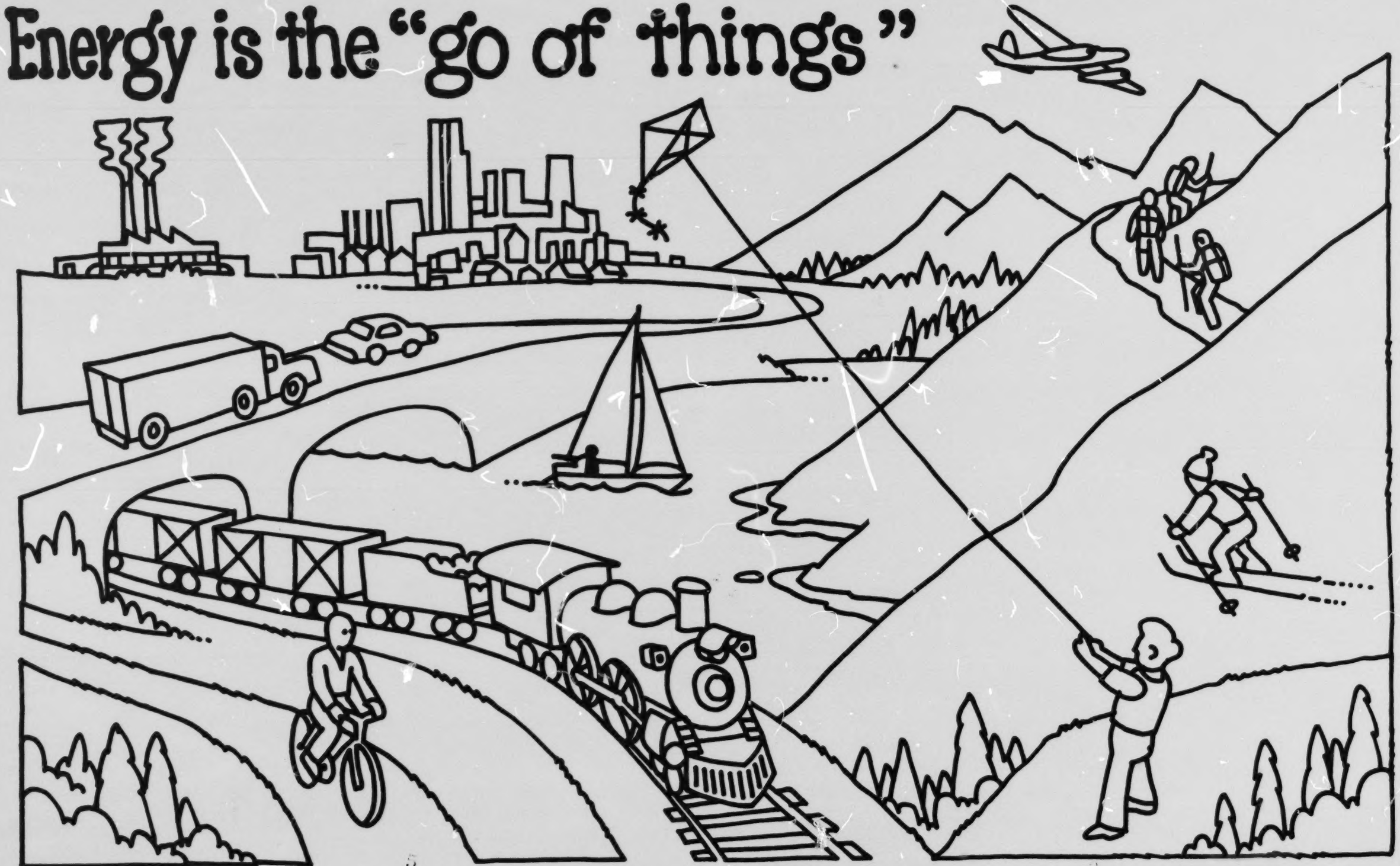
A Minnesota Energy Activity

Series A Card 1

Organizing Principle For Series A: What is energy? What does energy do? Where does energy come from?

Unit 1 Concept: Energy is the "go of things."

Energy is the "go of things"



Using This Unit

1. Show the children the photograph as you read the question. Allow ample time for discussion. Do not be concerned about "right" answers at this time. Instead, encourage everyone to contribute ideas and insights about energy and the many ways we use it. As a conclusion to the discussion, tell the children they will be doing activities that will help them discover more about energy.

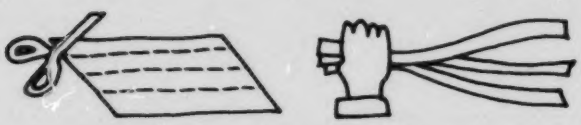
2. Select and carry through one or more of the *LEARNING ACTIVITIES.*

3. The study print—on the inside pages of the unit—is the culminating activity. The illustration shows many of the ways energy is used. From previous discussions and experiences with the *LEARNING ACTIVITIES,* children may conclude that "energy is the go of things."

Learning Activities

1. *WIND STREAMERS. Objective:* To observe that wind energy "gives things go." *Skills:* Observing, communicating. *Materials:* Newspaper, scissors.

Cut paper into strips 6-8 cm (2-3") wide (3-5 strips per child) and as long as the newspaper. Strips may be hand-held or be stapled to a cardboard handle. Take the streamers outside on a windy day. Hold them high. What happens? Observe the flag. Do the streamers and the flag move in the same direction? What is moving them? What else is the wind moving? (Smoke, dust, leaves, hair, etc.)

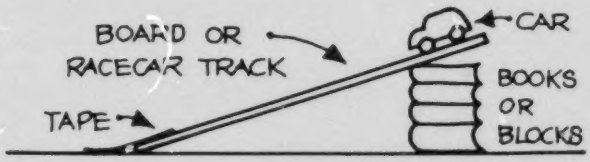


CUT PAPER STRIPS

HOLD IN WIND

2. *FAST AND FAR! Objective:* To observe the "go" of toy cars. *Skills:* Communicating, predicting. *Materials:* Short boards—30-50 cm (12-20")—or strips of toy car race track, small cars of near equal size and weight, tape.

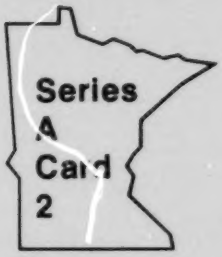
Divide the class into several teams and give each team the materials. Announce that the teams are going to have races to see how fast and how far their cars will go without being pushed. Make books and blocks available for inclining the track. (Tape is useful for holding track to the floor to create a smooth running surface.) What happens if you raise the track? When do cars have the most "go"?



3. *"GO" PICTURES. Objective:* To depict, through art, things that have "go." *Skills:* Observing, communicating. *Materials:* Drawing paper, crayons or color markers.

Have the children think about things they know that "go." You may want to recall the wind streamers and race cars. This may initiate discussion about other things that go. Then pass out paper and have each child draw something that goes. You may want to display pictures for a time. When the children take their artwork home, encourage them to talk about it with their parents. (You may prefer to make a mural instead of individual pictures.)

A Minnesota Energy Activity



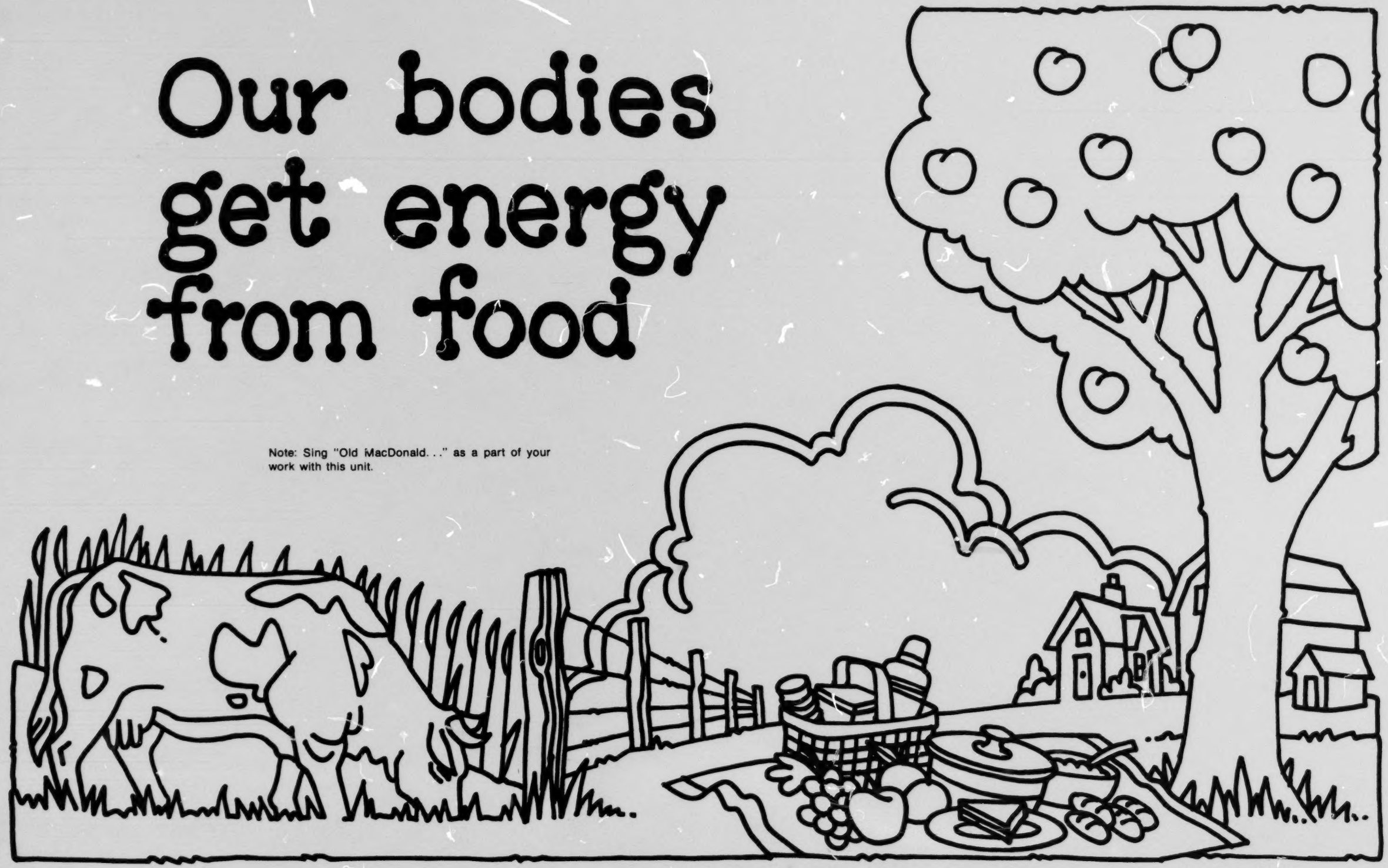
Organizing Principle For Series A: What is energy? What does energy do? Where does energy come from?

Unit 2 Concept: Our bodies need energy. Energy comes from the food we eat.

How do our bodies get energy?

Our bodies get energy from food

Note: Sing "Old MacDonald. . ." as a part of your work with this unit.



Using This Unit

1. Show the children the photograph as you read the question. Allow ample time for discussion. Do not be concerned about "right" answers at this time. Instead, encourage everyone to contribute ideas and insights about how our bodies get energy. As a conclusion to the discussion, tell the children they will be doing activities that will help them discover more about energy and their bodies.

2. Select and carry through one or more of the *LEARNING ACTIVITIES.*

3. The study print—on the inside pages of the unit—is the culminating activity. The illustration shows some of the sources of food we eat to give our bodies energy. From previous discussions and experiences with the *LEARNING ACTIVITIES,* children may conclude that "our bodies need energy" and "energy comes from the food we eat."

Learning Activities

1. *EXERCISE TIME. Objective:* To appreciate that physical activity requires energy. *Skills:* Observing, communicating.

Have the children sit quietly and put their hands over their hearts. Can they feel the beat? Then have them stand beside their chairs or, if there is room, form a circle. Do exercises that require little physical exertion—wiggle fingers, clap hands, etc. Check heartbeat again. Has anything changed? Go on to more energetic exercises—run in place, hop, do jumping jacks. Once more, ask the children to check their heartbeats. What has happened? Are there also changes in breathing? We use energy to exercise. Some exercises require more energy than others. What is an exercise that takes a lot of energy? How can we tell when our bodies are using a lot of energy? (Our heartbeat and breathing quicken; we may get warm; we may perspire.)

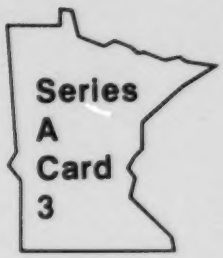
2. *ENERGY GIVER. Objective:* To consider food as the body's source of energy. *Skills:* Observing, inferring, communicating. *Materials:* Enough apples for each child to have part of one, a knife.

Pass around an apple. Observe it and discuss. Is this a fruit or a vegetable? Where does it grow? What uses are made of apples? (Jelly, cider, juice, apple butter, etc.) Cut the apples and share slices with the class. What will apples do for our bodies? (Give them energy; make them grow bigger, taller, stronger.) What foods other than apples do we eat for snacks?

3. *FOOD POSTER. Objective:* To classify foods. *Skills:* Classifying, communicating. *Materials:* Seed catalogs, magazines, scissors, paste or glue, large piece of tagboard or other suitable poster paper.

Give the children the catalogs, magazines, and scissors. Ask them to search for and cut out all the food pictures they can find. Have each child select one picture. Is it food from a plant? Is it food from an animal? A food from both plant and animal? Paste the pictures on a poster divided into three parts—plant, animal, both plant and animal. (To simplify the activity look only for plant food pictures and animal food pictures.) Decide on a poster title that states that our bodies use food for energy. Display the poster.

A Minnesota Energy Activity

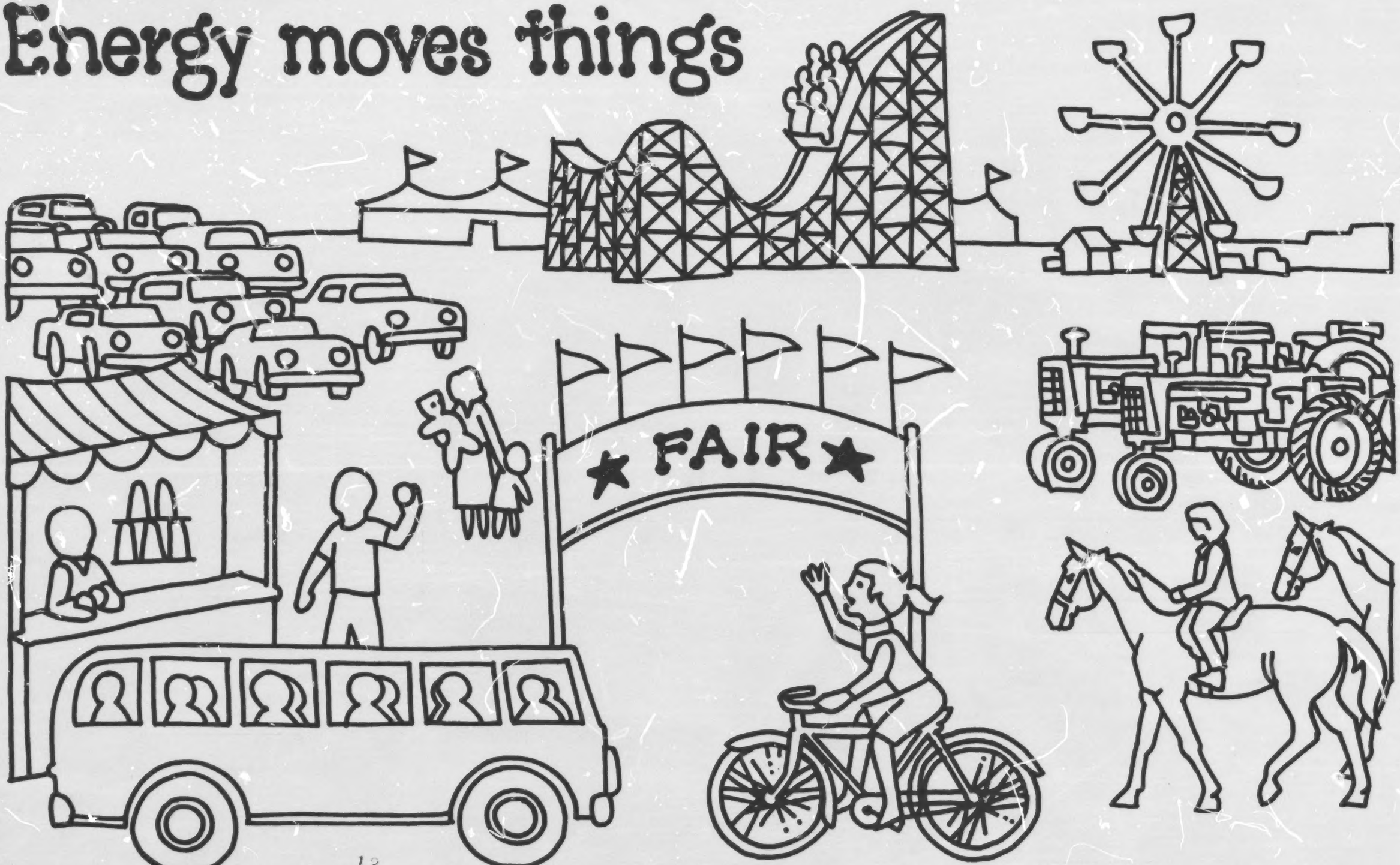


Organizing Principle For Series A: What is energy? What does energy do? Where does energy come from?

Unit 3 Concept: Energy moves things. The energy to move things comes from many sources.

What will make a bicycle move?

Energy moves things



Using This Unit

1. Show the children the photograph as you read the question. Allow ample time for discussion. Do not be concerned about "right" answers at this time. Instead, encourage everyone to contribute ideas and insights about the many things that need energy to make them move. As a conclusion to the discussion, tell the children they will be doing activities that will help them discover that energy moves things.

2. Select and carry through one or more of the *LEARNING ACTIVITIES.*

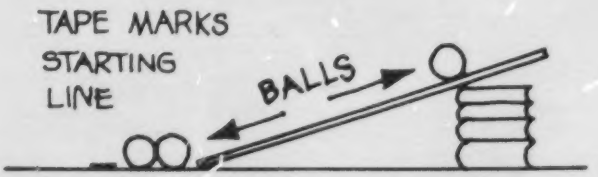
3. The study print—on the inside pages of the unit—is the culminating activity. The illustration shows a fair in which there is much movement—people, machines, flags. From previous discussions and experiences with the *LEARNING ACTIVITIES,* children may conclude that "energy moves things" and that "energy from movement comes from many sources."

Learning Activities

1. *THE ENERGY BUMP. Objective:* To discover that energy can be transferred from one object to another. *Skills:* Communicating, predicting, measuring. *Materials:* Lengths of plastic race track (or cardboard, blocks, boards, or whatever will serve as runway material), tape, small balls (golf, ping pong, tennis).

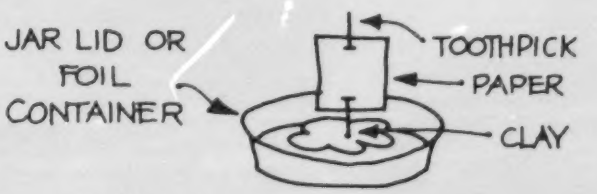
Divide the class into small teams. Give each team runway material and at least three balls. Make books or blocks available for inclining the track. Put tape at the end of the track as the "starting line." Place one ball just behind the starting line. What will happen if we roll a ball down the track and into another ball? Have children predict the outcome. (The energy of the rolling ball is transferred to the stationary ball and makes it move.)

Experiment with balls of various sizes. How far does a ball that is hit move from the starting line? How can we make it go farther? What happens if we place more than one ball at the end of the track?



2. *BUILD-A-BOAT. Objective:* To create a model that uses wind as a source of energy. *Skills:* Experimenting, observing, communicating. *Materials:* Odds and ends such as foil containers from TV dinners, wood scraps, clay, pipe cleaners, toothpicks, jar lids, container for a "lake."

Children may invent and test boats by themselves. You might prefer to show them a model based on the illustration.



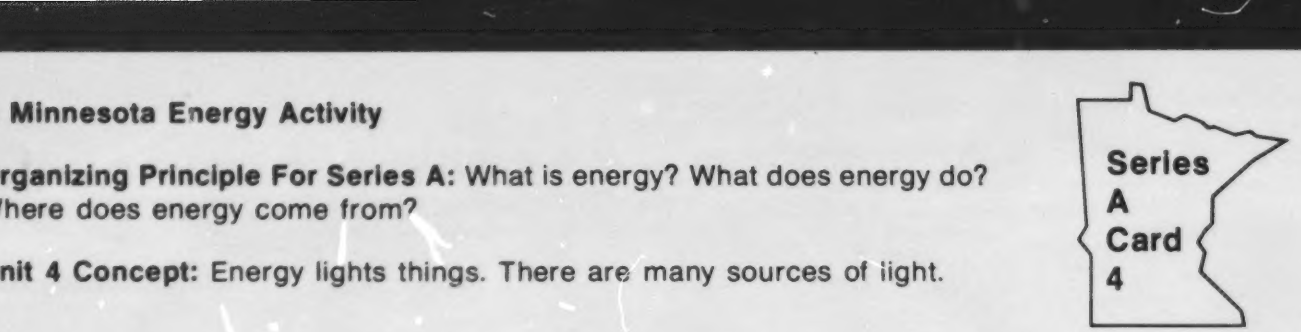
3. *WHAT IS MOVING? Objective:* To participate in a game that relates energy to movement. *Skills:* Observing, communicating.

Machines move things. Ask the children to think of machines they can pretend to be. Then take turns pantomiming. If those watching cannot guess the answers, the children pantomiming can give some verbal clues.

A Minnesota Energy Activity

Organizing Principle For Series A: What is energy? What does energy do? Where does energy come from?

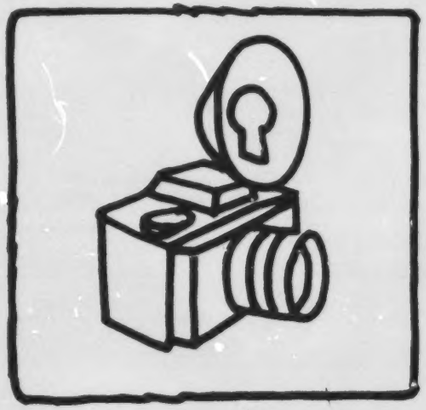
Unit 4 Concept: Energy lights things. There are many sources of light.

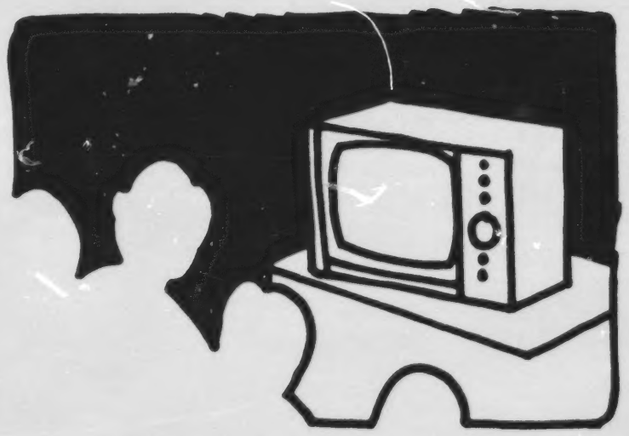


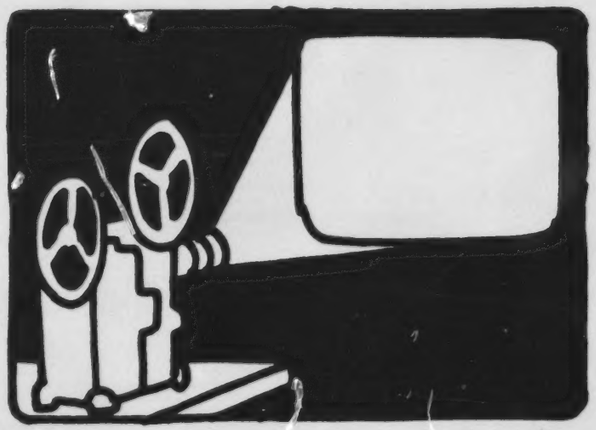
Where does light come from?

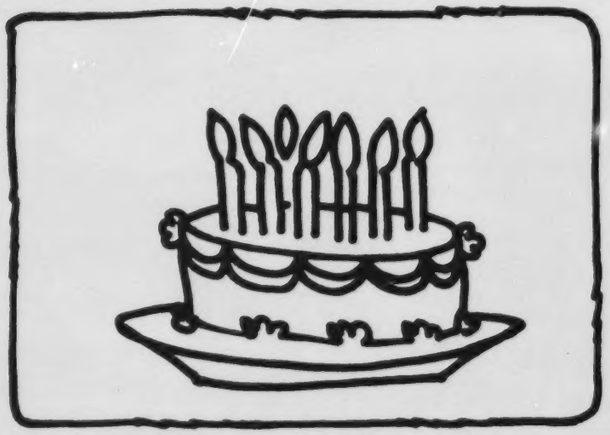
Energy lights things

LINCOLN SCHOOL









Using This Unit

1. Show the children the photograph as you read the question. Allow ample time for discussion. Do not be concerned about "right" answers at this time. Instead, encourage everyone to contribute ideas and insights about light and the uses we make of it. As a conclusion to the discussion, tell the children they will be doing activities that will help them discover more about energy lighting things.

2. Select and carry through one or more of the *LEARNING ACTIVITIES*.

3. The study print—on the inside pages of the unit—is the culminating activity. The illustration shows many of the ways energy is used as light (sunlight, flash camera, movies, etc.). From previous discussions and experiences with the *LEARNING ACTIVITIES*, children may conclude that "energy lights things" and that "there are many sources of light."

Learning Activities

1. *LIGHT ART. Objective:* To identify light sources in the environment. *Skills:* Observing, gathering data, communicating. *Materials:* Catalogs, magazines, scissors, paste or glue, paper for posters.

Have the children look for and cut out pictures of anything that gives light. These pictures may be used to create individual collages or to make a class collage. If you make a class collage, have the children give it an appropriate, energy-related title.

2. *LIGHT GRAB BAG. Objective:* To identify energy-related objects through touch. *Skills:* Observing, inferring, communicating. *Materials:* Grocery bag, candle, flashlight, book of matches, small piece of wood, lightbulb such as found in a nightlight.

MAKE GRABBAG FROM LARGE PAPER BAG

Place the objects in the bag. Children take turns reaching into the bag and trying to identify individual objects by touch. The only clue is that each object can be used to make light. Discuss how the objects produce light. (Light the candle, burn the wood, connect the bulb to a source of energy.)

3. *FLASHLIGHT FUN. Objective:* To explore the makeup of a flashlight. *Skills:* Observing, problem-solving, divergent thinking. *Materials:* One or several workable flashlights.

If you use more than one flashlight, assign them to individuals or groups so that when the flashlights are taken apart the pieces won't become intermixed. Children may simply try out, take apart, examine, and attempt to reassemble the flashlights. Or you may challenge a group to make what it can from the parts of a disassembled flashlight. Where does the energy for the light come from? (Batteries. Energy is stored in the batteries waiting to be used.) What turns the energy on or off? (Switch.) What uses do people have for flashlights? (Campers, doctors, miners, dentists, and ushers are some of the people who use some form of flashlight.)

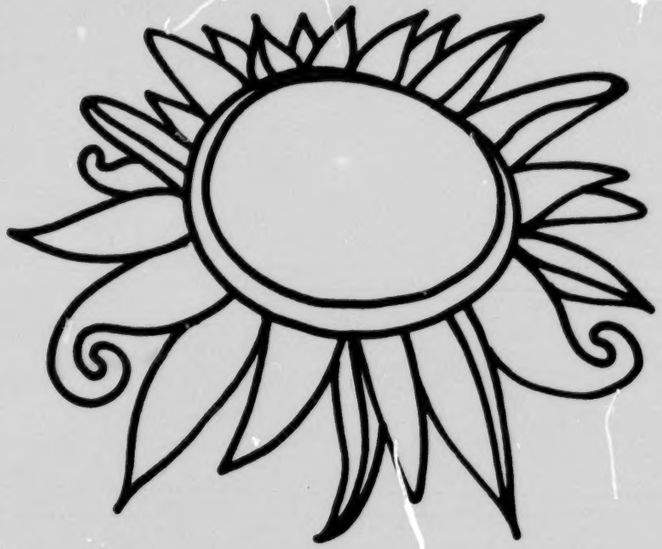
A Minnesota Energy Activity

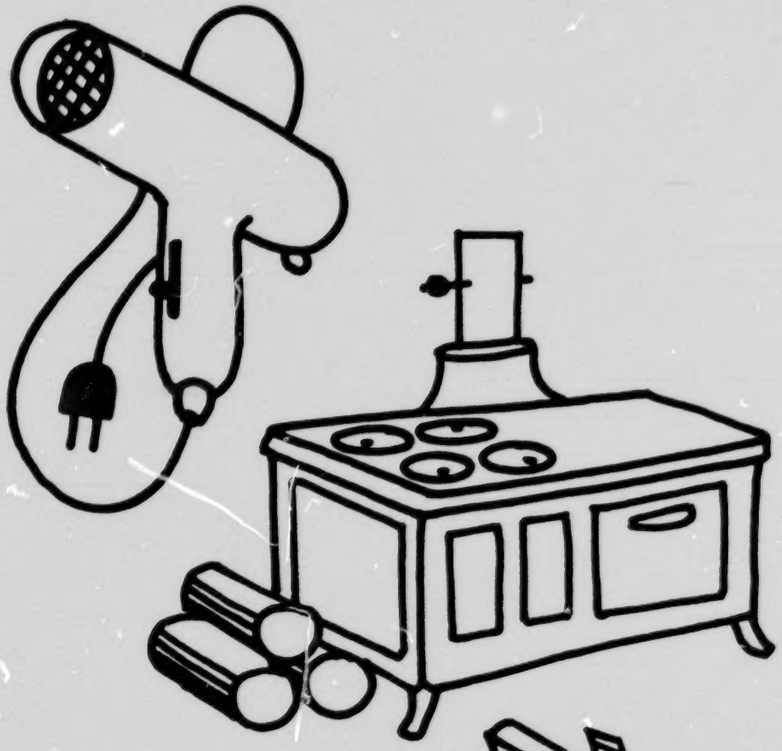
Series A Card 5

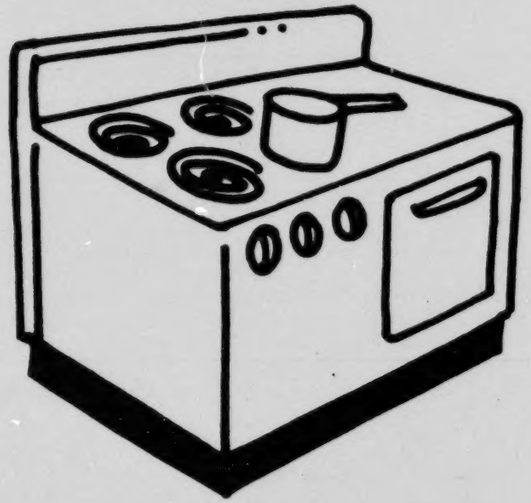
Organizing Principle For Series A: What is energy? What does energy do? Where does energy come from?

Unit 5 Concept: Energy heats things. There are many sources of heat.

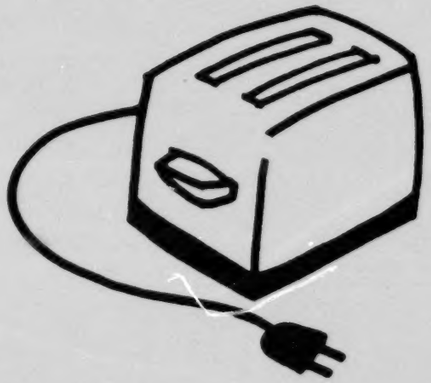
How can we heat up a hot dog?

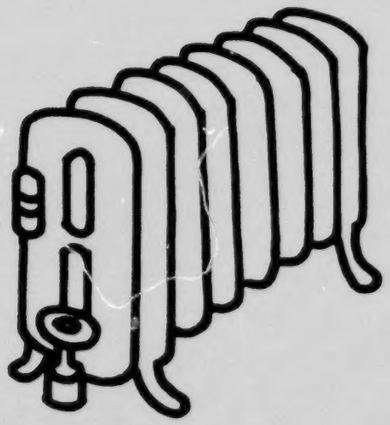


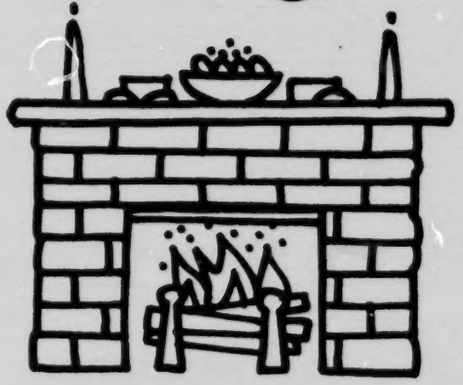


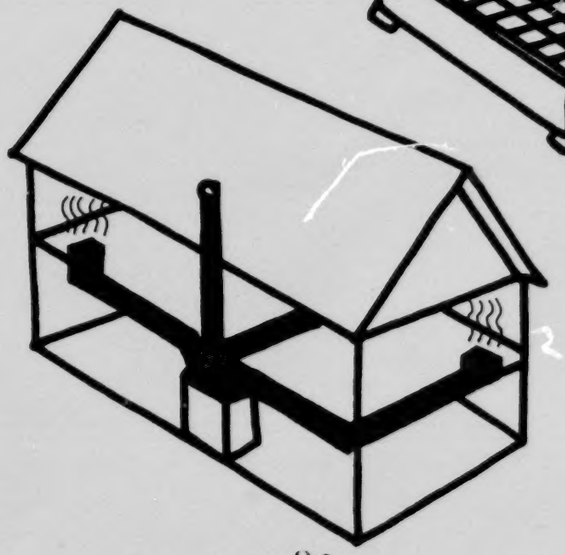


Energy heats things









Using This Unit

1. Show the children the photograph as you read the question. Allow ample time for discussion. Do not be concerned about "right" answers at this time. Instead, encourage everyone to contribute ideas and insights about how we heat things. As a conclusion to the discussion, tell the children they will be doing activities that will help them discover that energy heats things.

2. Select and carry through one or more of the *LEARNING ACTIVITIES.*

3. The study print—on the inside pages of the unit—is the culminating activity. The illustration shows a grouping of heat-producing things. From previous discussions and experiences with the *LEARNING ACTIVITIES,* children may conclude that "energy heats things" and that "there are many sources of heat."

Learning Activities

1. *HEAT GENERATORS. Objective:* To discover that we can produce heat. *Skills:* Observing, inferring, communication. *Materials:* Sandpaper, small hammer, large nails, a thick lumber scrap into which nails can be driven.

Have children rub their hands vigorously, palm-to-palm. What happens? (Heat is generated.) What will happen if we rub sandpaper on wood? (It will smooth the wood and generate heat.) Will rubbing harder produce more or less heat? Pound a large nail part way into a board. Then let a child hammer the nail repeatedly. Feel the hammerhead and nail. What has happened? (Heat has been produced.)

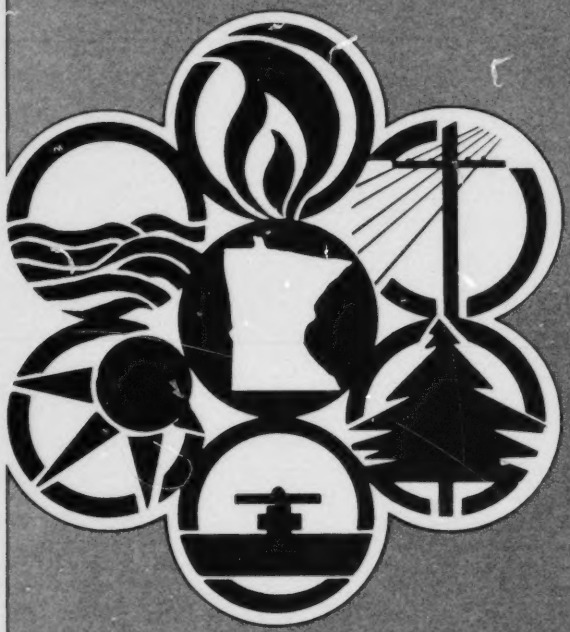
RUB PALMS VIGOROUSLY

2. *WARM SPOTS, COOL SPOTS.* (This activity is most effective during the heating season.) *Objective:* To relate heat energy to the child's immediate environment. *Skills:* Gathering and analyzing data, communicating.

Have the children move about the room and find places and things that feel warm. (Radiator, heat vents, lights, inner walls, etc.) Tape a red paper flame to "warm" objects. Then search for places and objects that feel cool to the touch. (Closet, floor, windows, etc.) Tape a blue icicle to "cool" objects. Why are some areas and objects warm while others are cool?

3. *COURTESY OF THE CUSTODIAN. Objective:* To investigate energy use in the school. *Skills:* Observing, communicating.

Arrange with the custodian to take the class on a field trip to the furnace room. Ask the custodian to tell the children something about how the furnace works and how the heat reaches the classrooms. What fuel is used? How does the fuel get to the school? Encourage questions. In conclusion, ask the custodian to mention things children can do to conserve energy in the school building. Invite suggestions from the children as well. (You may extend this activity into the home by asking children to observe how their homes are heated and to talk to their parents about the kind of fuel the family uses.)



Minnesota Energy Activities

For Elementary Students

Minnesota Department Of Education
Minnesota Energy Agency

LEVEL A for Ages 4-6

WHAT IS ENERGY? WHAT DOES ENERGY DO? WHERE DOES ENERGY COME FROM?

1. Energy is the "go" of things.
2. Our bodies need energy. Energy comes from the food we eat.
3. Energy moves things. The energy to move things comes from many sources.
4. Energy lights things. There are many sources of light.
5. Energy heats things. There are many sources of heat.

LEVEL B for Ages 5-7

WE FIND ENERGY IN MANY PLACES

1. We get energy from the sun.
2. We get energy from the wind.
3. We get energy from water.
4. We get energy from wood, coal, oil, and gas.
5. We use the energy of electricity.

LEVEL C for Ages 6-8

ENERGY DOES ALL THE WORK IN THE WORLD

1-2. Work happens when something moves or changes.
3-4. Energy has to be put into a machine before we can get work out of it.
5-6. People invent machines to do work.
7-8. There are more machines now than in the past.
9. Some of the machines we use today are more important to us than others.
10. In some countries people use fewer machines and less energy than we do.

LEVEL D for Ages 7-9

THE EARTH'S ENERGY SOURCES ARE LIMITED

1-2. Major energy sources in use today are unevenly distributed around the world and must be transported to where they are needed.
3-4. Energy sources are either renewable or nonrenewable.
5-6. Cutting consumption is a way to conserve energy.
7-8. Insulating is a way to conserve energy.
9-10. Recycling is a way to conserve energy.

LEVEL E for Ages 8-10

ENERGY CHANGES FROM ONE FORM TO ANOTHER

1-2. Energy is either waiting (potential energy) or it is working (kinetic energy).
3-4. We use some forms of energy without changing them.
5-6. Energy can be changed (converted) from one form to another to make it more useful.
7-8. There are natural and technological conversion systems.
9-10. Energy is wasted in conversion.

LEVEL F for Ages 9-11

THE ENERGY SITUATION AFFECTS MINNESOTANS TODAY

1-2. Minnesota has special energy problems.
3-4. The cost of energy has an economic impact on families.
5-6. Jobs are dependent on energy availability.
7-8. Energy use has environmental consequences.
9-10. Conservation is everybody's business.

LEVEL G for Ages 10-13

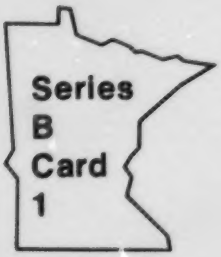
THE ENERGY SITUATION WILL AFFECT THE FUTURE

1-2. Because Minnesota's energy resources are limited, we need to look at alternative sources.
3-4. Alternative energy sources continue to be developed.
5-6. By making use of wastes, we conserve energy.
7-8. The energy situation has an international impact.
9-10. Further advances in energy-related technology will have an impact on our lives that is difficult to imagine.

A Minnesota Energy Activity

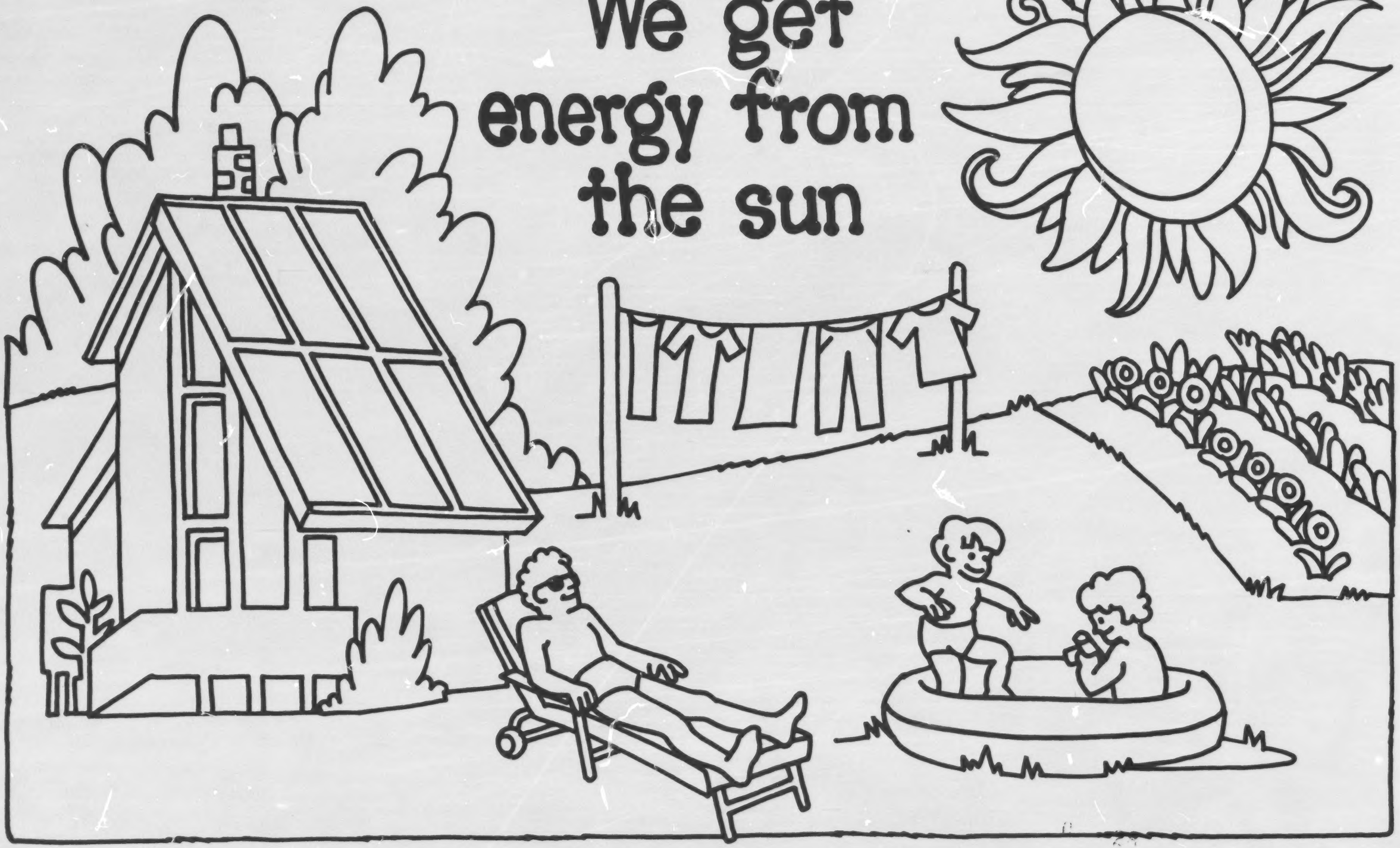
Organizing Principle For Series B: Energy comes from many sources.

Unit 1 Concept: We get energy from the sun.



What does the sun do?

We get energy from the sun



Using This Unit

1. Show the children the photograph as you read the question. Allow ample time for discussion. Do not be concerned about "right" answers at this time. Instead, encourage everyone to contribute ideas and insights about the sun and the ways we use its light energy and heat energy. As a conclusion to the discussion, tell the children they will be doing activities that will help them discover more about the sun and its energy.

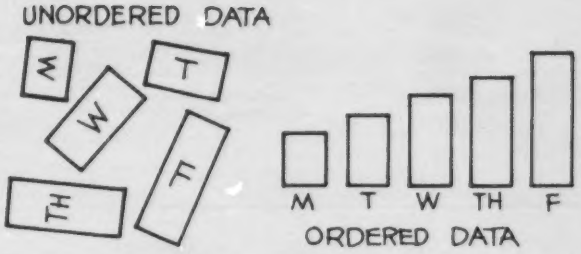
2. Select and carry through one or more of the *LEARNING ACTIVITIES.*

3. The study print—on the inside pages of this unit—is the culminating activity. The illustration shows many of the ways the sun's energy can be used. (Dries clothes, warms water, makes plants grow, tans skin, heats.) From previous discussions and experiences with the *LEARNING ACTIVITIES,* children may conclude that "energy comes from the sun" and "we use the sun's energy in many ways."

Learning Activities

1. *SUN POWER. Objective:* To discover that sunlight affects plant growth. *Skills:* Predicting, observing, measuring, communicating. *Materials:* Enough bean seeds, potting soil, and milk carton planting containers to supply several teams.

Divide the class into teams. Have each team plant 3-5 seeds. Glue or tape at least one seed to the outside of the container. Discuss. Where might plants grow the best? Where might they not grow much at all? How can we find out? Plant seeds and water regularly. After seeds sprout, chart growth by cutting strips of paper equal to the height of the plants. Order data as illustrated.



2. *WATER HEATER. Objective:* To recognize that the sun is a source of heat. *Skills:* Communicating, predicting, measuring. *Materials:* Two identical containers large enough to immerse a child's hand, water.

Fill containers with equal amounts of cold water. Have the children feel the water with their hands. Place one container in the sun and the other in the shade. What do you think will happen to the water in the sun? In the shade? In an hour, have the children test the water with their hands. What has happened? Why?

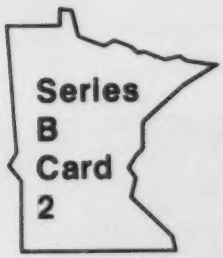
3. *SUN PICTURES.* (This activity works best in early fall or late spring.) *Objective:* To recognize that energy from the sun changes things. *Skills:* Predicting, observing. *Materials:* Construction paper in dark colors, leaves, shells, rocks, other objects with interesting shapes or paper cut in various shapes.

Around midday, have the children place pieces of construction paper outside in the bright sun. Arrange objects on top of the paper. (Leaves or paper cutouts must be pinned or secured with double-sided tape.) What do you think will happen? After 2-3 hours take the papers in. Discuss what has happened. (Sunlight faded the paper. The sun can change things.) Pass the papers out at random and ask the children to match objects to the prints. Turn the activity into an art project by having the children outline the shapes with chalk or crayon. The shapes might suggest something real or fanciful which the children then incorporate into a picture, giving their imaginations free play.

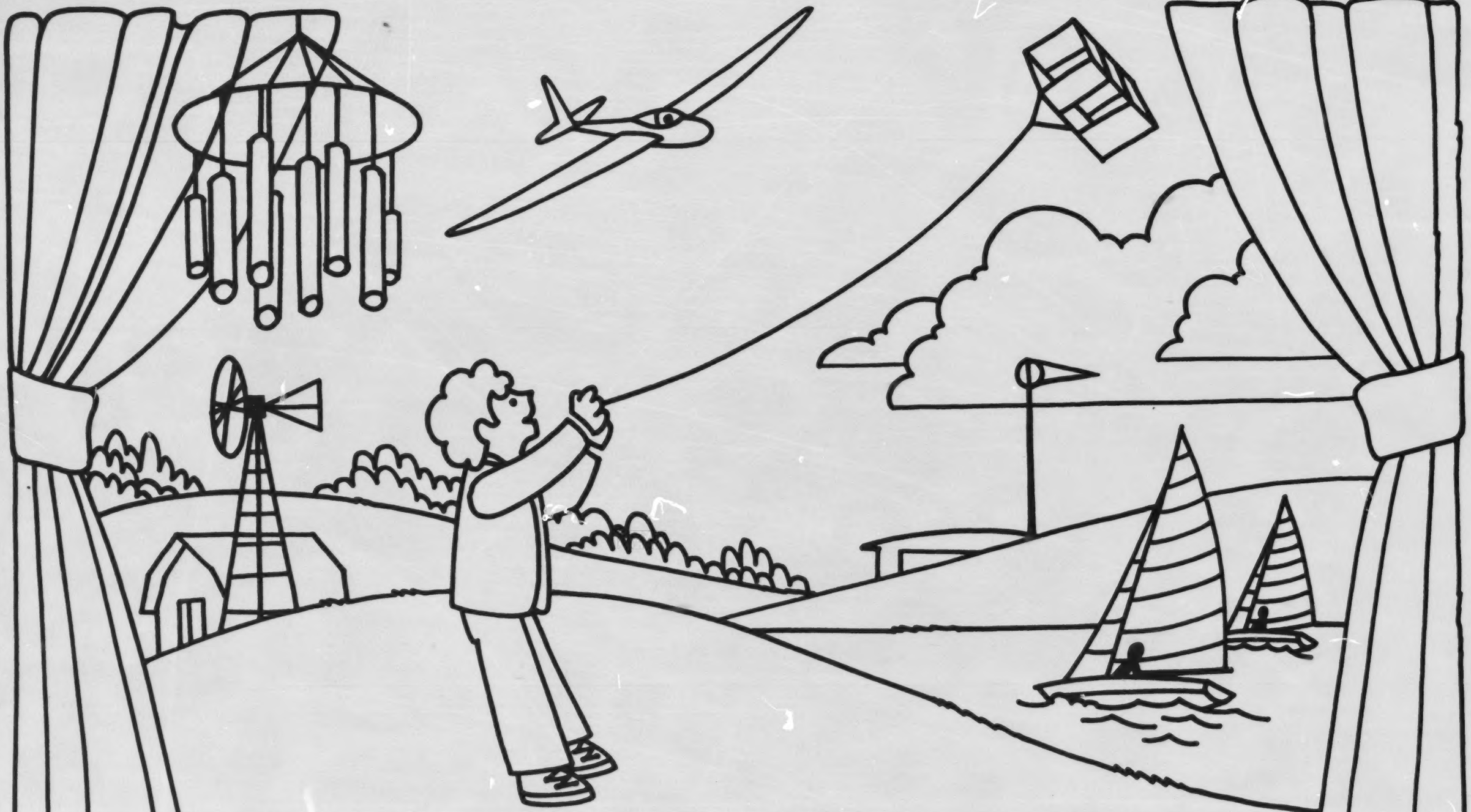
A Minnesota Energy Activity

Organizing Principle For Series B: Energy comes from many sources.

Unit 2 Concept: We get energy from wind.



What does wind do?



We get energy from wind

Using This Unit

1. Show the children the photograph as you read the question. Allow ample time for discussion. Do not be concerned about "right" answers at this time. Instead encourage everyone to contribute ideas and insights about wind and what it does. As a conclusion to the discussion, tell the children they will be doing activities that will help them discover more about the wind and its energy.

2. Select and carry through one or more of the *LEARNING ACTIVITIES.*

3. The study print—on the inside pages of this unit—is the culminating activity. The illustration shows many of the ways wind energy may be used. From previous discussions and experiences with the *LEARNING ACTIVITIES,* children may conclude that "the wind has energy" and "we can use the wind's energy in many ways."

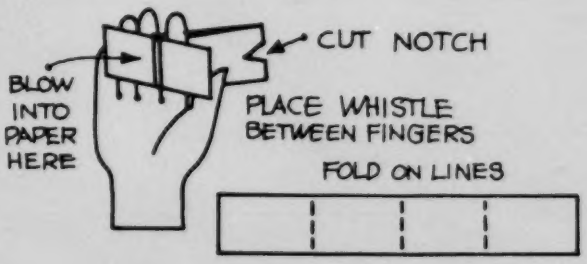
Learning Activities

1. *PINWHEEL-WINDMILLS. Objectives:* To recognize that we get energy from the wind. *Skills:* Observing, conducting experiments, communicating. *Materials:* Paper for duplicating the Pinwheel Pattern which is included in Series B, straight pins, scissors, pencils with erasers, drinking straws.

Make a pinwheel from the pattern. What will make pinwheels spin? (Wind, fan, breath.) What makes them go the fastest? (Pinwheels may also be used to make observations about prevailing winds.)

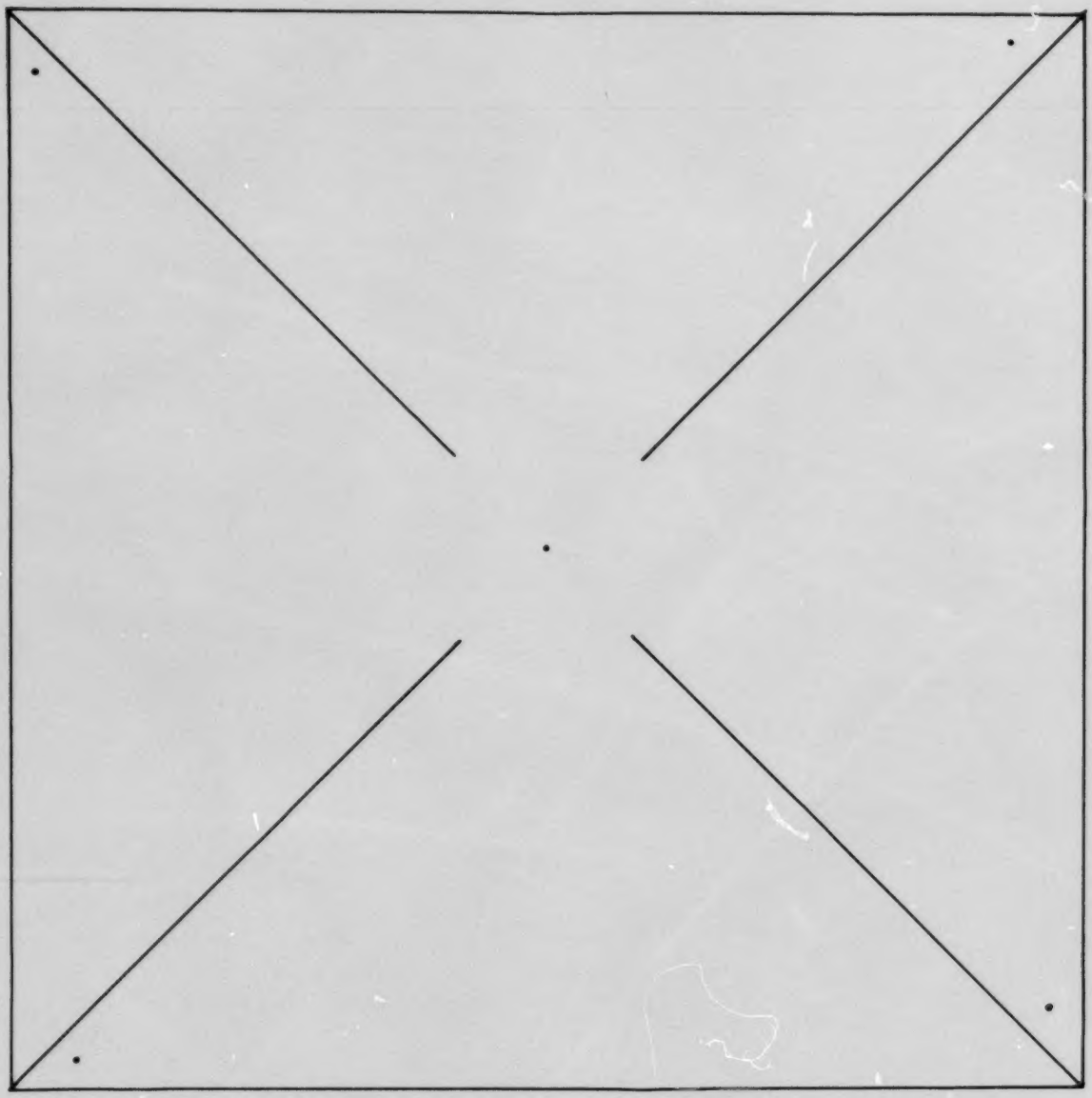
2. *WIND WHISTLES. Objective:* To discover that wind energy creates sound. *Skills:* Observing, designing experiments, communicating. *Materials:* Typing paper, scissors.

Cut out paper rectangles—approximately 5 by 15 cm (2 by 6")—and fold in fourths as indicated. Cut a small notch in the center fold. Display example for the children. Ask them to guess what will happen if you blow into the paper. Demonstrate. Then make whistles. What can be done to change the sound? What happens if you blow harder or change the hole size? How else does wind make sound? (Makes music come out of musical instruments, rustles leaves, "howls" in a storm, etc.)



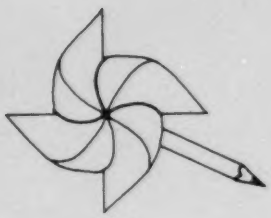
3. *WIND WRITINGS. Objective:* To creatively express ideas about wind. *Skills:* Observing, communicating. *Materials:* Chalkboard or chart.

Ask the children to think about the wind and then share thoughts. How does wind feel when it's warm? When it's cold? What does wind do when it's blowing on your back? What sounds does wind make? Are they friendly sounds? Scary? Together as a class, write a story or poem—there's no need for rhyme—about the wind. Decide on a theme such as "The wind is my friend" and have the children contribute ideas or lines. The class might then illustrate what has been written by creating a wind mural or drawing pictures for a bulletin board display.



PINWHEEL-WINDMILL PATTERN

1. CUT ON SOLID LINES.
2. FOLD DOT-MARKED POINTS TO CENTER.
3. FASTEN TO PENCIL ERASER WITH PIN.

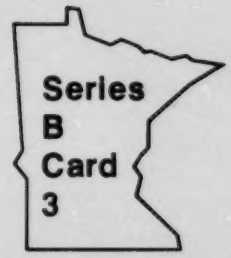


A MINNESOTA ENERGY ACTIVITY
(Information card to accompany
Card 2 of Series B)

A Minnesota Energy Activity

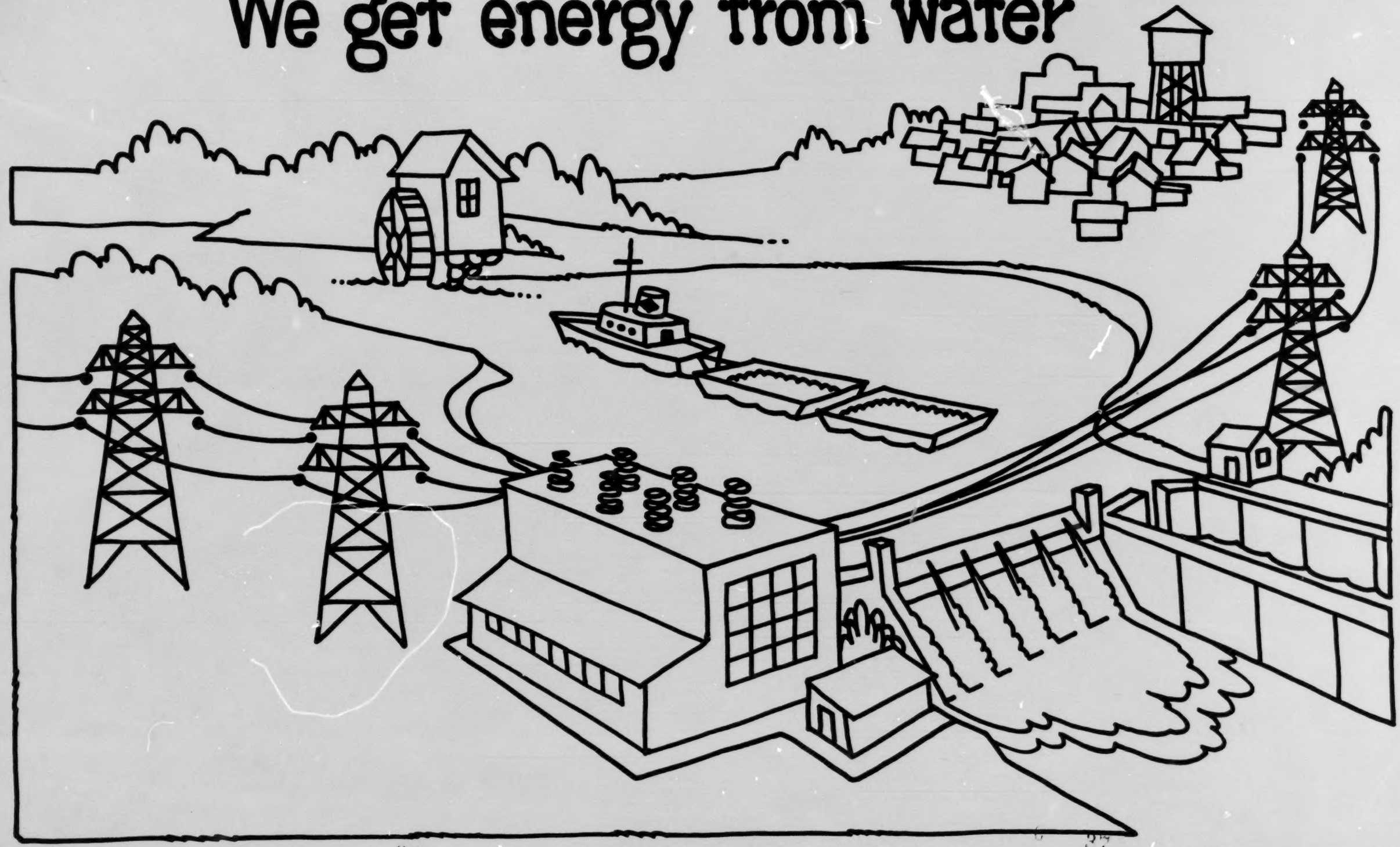
Organizing Principle For Series B: Energy comes from many sources.

Unit 3 Concept: We get energy from water.



What does water do?

We get energy from water



Using This Unit

1. Show the children the photograph as you read the question. Allow ample time for discussion. Do not be concerned about "right" answers at this time. Instead, encourage everyone to contribute ideas and insights about where water is found and the uses we make of it. As a conclusion to the discussion, tell the children they will be doing activities that will help them discover more about water and its energy.

2. Select and carry through one or more of the *LEARNING ACTIVITIES.*

3. The study print—on the inside pages of this unit—is the culminating activity. The illustration shows ways water energy may be used. From previous discussions and experiences with the *LEARNING ACTIVITIES,* children may conclude that "there is energy in moving water" and "we can use the water's energy in many ways."

Learning Activities

1. *WATER WONDER. Objective:* To explore water. *Skills:* Designing experiments, observing, communicating. *Materials:* Plastic or metal pitcher, sink or small tub, water, corks, other objects that float.

Have children pour water from the pitcher into the sink or tub. What happens when you pour slowly from near the container? What if you pour faster from a greater height? When does falling water hit the hardest?

Partially fill a sink or small tub. Add corks, small boats, or other objects that float. Stir the water. What happens? (The movement of the water provides energy to make floating things go.)

As an alternative, have cork races to see who can get a cork across the water the fastest. All energy must come from movement of the water.

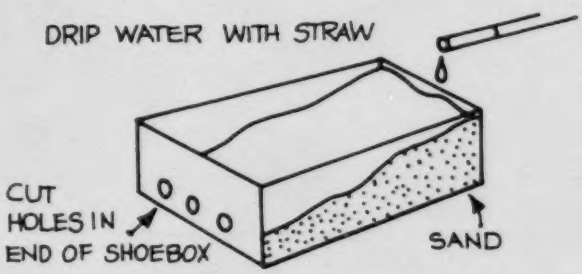
2. *WATERWHEEL. Objective:* To recognize that moving water is a source of energy. *Skills:* Designing experiments, observing, predicting. *Materials:* Cardboard, tagboard, masking tape, nail, source of running water.

Use the Waterwheel Pattern included in Series B to make a waterwheel. Display the model and discuss. What is a waterwheel? How is it used? Have the children pour water so it hits the tabs or "paddles." What will faster running water do to the wheel? (Place the wheel under stream of water from a faucet.)

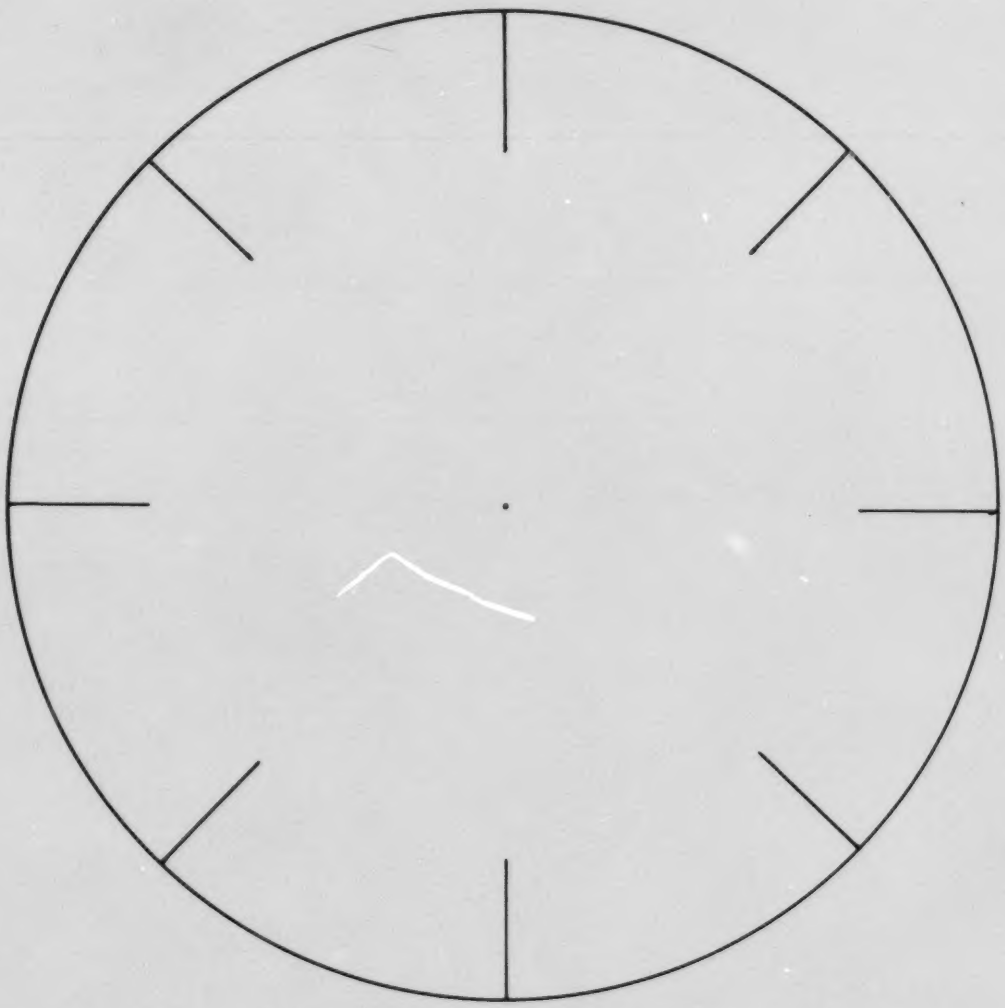
3. *EROSION MODEL.* (This is a good activity to do the day after a rain.) *Objective:* To recognize that water has the power to move things. *Skills:* Designing experiments, analyzing, observing. *Materials:* Plastic garbage bag, straw, shoebox one-fourth full of sand, scissors, pitcher of water.

Spread open the garbage bag and do the activity on it. The bag will catch the sand and water, making for easy disposal. Cut small holes in one end of the shoebox. Slope the sand. Use a straw to drip a few drops on the sand. Let everyone observe how water will change the shape of the sand's surface. Talk about what might happen if more water falls, then try it.

After the demonstration, go outside and look for signs of erosion. (Check near downspouts, storm sewer drains, slopes. You may find the water has moved roofing granules, leaves, twigs, earth, etc.)



INFORMATION CARD



WATERWHEEL PATTERN

CUT OUT 2 CARDBOARD CIRCLES THE SIZE OF THE PATTERN.

TAPE CARDBOARD CIRCLES TOGETHER.

CUT SLOTS

INSERT SQUARES OF TAGBOARD FOR BLADES

PUSH NAIL THROUGH CENTER

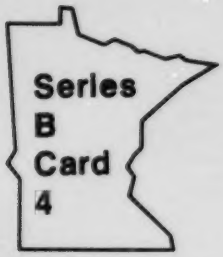
HOLD WATERWHEEL UNDER STREAM OF WATER.

A MINNESOTA ENERGY ACTIVITY
(Information card to accompany Card 3 of Series B)

A Minnesota Energy Activity

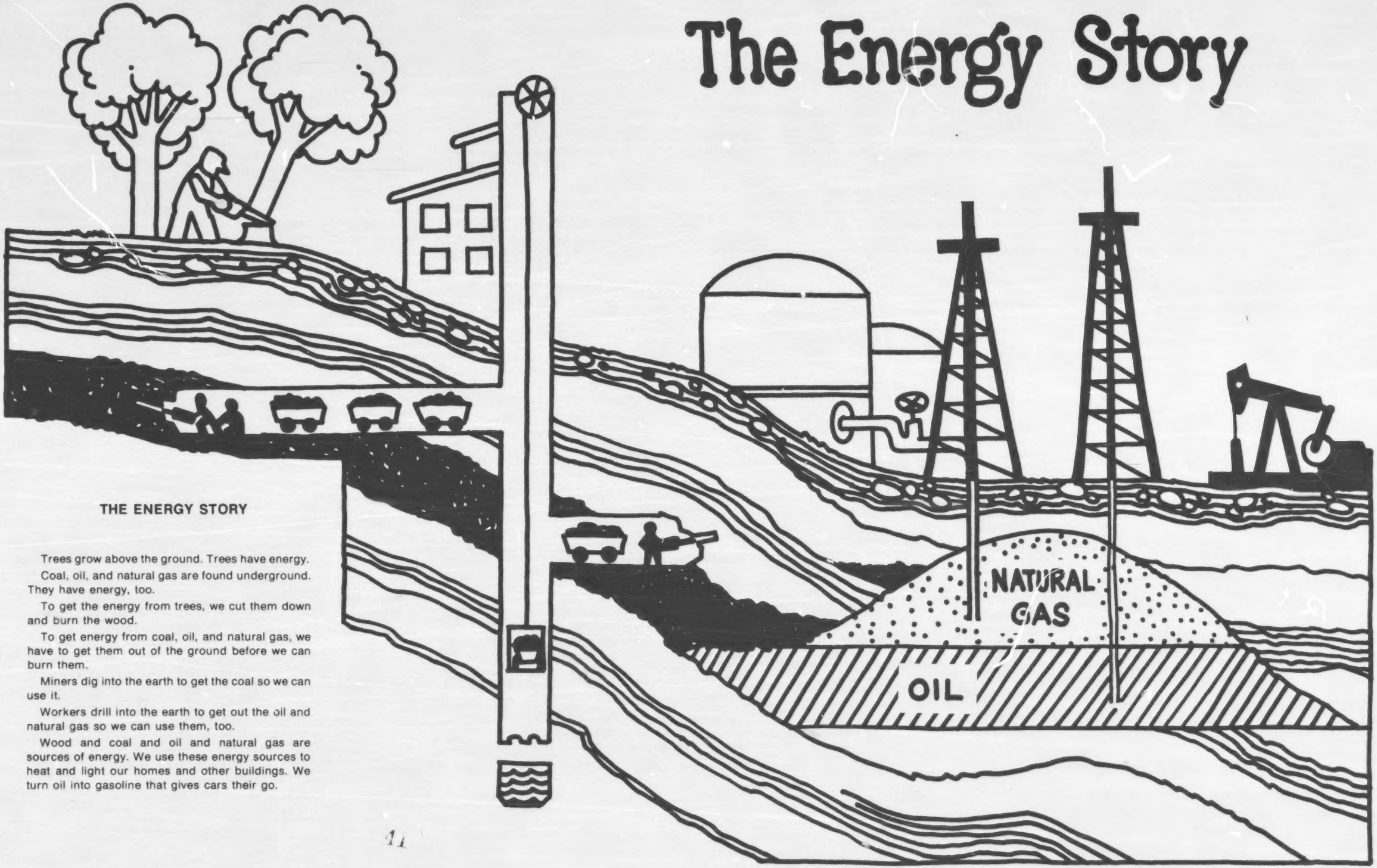
Organizing Principle For Series B: Energy comes from many sources.

Unit 4 Concept: We get energy from wood, coal, oil, and gas.



Where does heat for cooking come from?

The Energy Story



THE ENERGY STORY

Trees grow above the ground. Trees have energy.

Coal, oil, and natural gas are found underground. They have energy, too.

To get the energy from trees, we cut them down and burn the wood.

To get energy from coal, oil, and natural gas, we have to get them out of the ground before we can burn them.

Miners dig into the earth to get the coal so we can use it.

Workers drill into the earth to get out the oil and natural gas so we can use them, too.

Wood and coal and oil and natural gas are sources of energy. We use these energy sources to heat and light our homes and other buildings. We turn oil into gasoline that gives cars their go.

Using This Unit

1. Show the children the photograph as you read the question. Allow ample time for discussion. Do not be concerned about "right" answers at this time. Instead, encourage everyone to contribute ideas and insights about the heat we use for cooking. At the conclusion of the discussion, turn to the study print on inside pages and read "The Energy Story." Give the children time to look at the illustration and ask questions. Then tell them they will be doing activities that will help them discover more about the energy of wood, coal, oil, and natural gas.

2. Select and carry through one or more of the *LEARNING ACTIVITIES.*

3. Learning activity #3 explains how to use the study print as the culminating activity. From previous discussions and experiences with the *LEARNING ACTIVITIES,* children may conclude that "energy comes from wood, coal, oil, and natural gas" and that "we use the energy from these sources in many ways."

Learning Activities

1. *ENERGY INTEREST CENTER. Objective:* To identify energy sources and some of their uses. *Skills:* Observing, communicating. *Materials:* Wood, coal, and oil samples. (Do not display gasoline.)

Show the children the samples and discuss their use. Explain that the oil that comes out of the ground is made into many products we burn—fuel oil, gasoline, kerosene, etc. You may want to refer to "coal" and "petroleum" in the encyclopedia for pictures and diagrams. Share these with the class and display the books in the interest center. Invite children to contribute pictures and/or information to the center.

Note: Since many of the wood, coal, and oil byproducts are flammable, this is a good time to work in a unit on fire safety.

2. *GAS STATION GUESTS. Objective:* To participate in an energy-related field trip. *Skills:* Observing, communicating.

Arrange with a service station manager for permission to bring the class on a field trip. Ask that the person giving the tour tell something about transportation and storage of gas as well as gas allocation. The children should see oil samples and have a demonstration of how a gas pump works. Encourage questions. As an alternative to the field trip, invite an attendant to the classroom. Extend the activity by having the class compose a "thank you" letter telling something of what they learned.

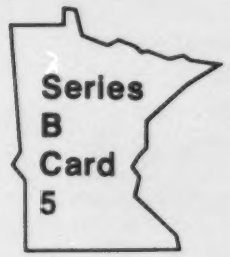
3. *STUDY PRINT ART. Objective:* To relate energy uses to their sources. *Skills:* Observing, classifying, communicating. *Materials:* This Unit 4 study print, drawing paper, crayons, yarn, scissors, tape, pushpins.

Show the children the study print on inside pages and have them share what they now know about the energy sources pictured. Then invite them to draw pictures showing how one of these sources is being used. Arrange the pictures around the study print on the bulletin board. Have the children identify the sources that relate to their pictures. Connect the pictures to the sources with pieces of yarn.

A Minnesota Energy Activity

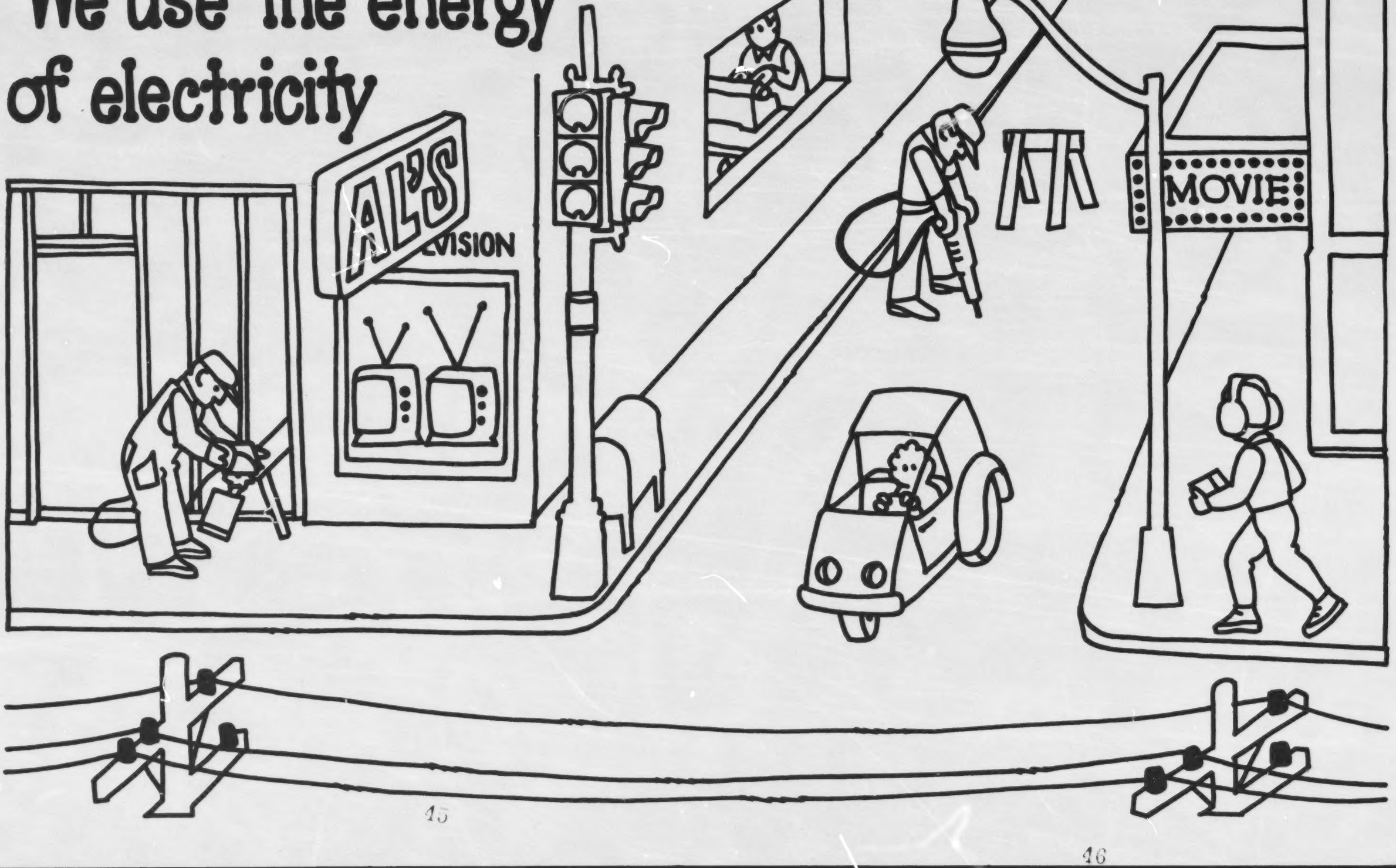
Organizing Principle For Series B: Energy comes from many sources.

Unit 5 Concept: We use the energy of electricity.



How do we use electricity?

We use the energy of electricity



Using This Unit

1. Show the children the photograph as you read the question. Allow ample time for discussion. Do not be concerned about "right" answers at this time. Instead, encourage everyone to contribute ideas and insights about the uses we make of electricity. As a conclusion to the discussion, tell the children they will be doing activities that will help them discover more about electricity and how we use it.

2. Select and carry through one or more of the *LEARNING ACTIVITIES.*

3. The study print—on the inside pages of this unit—is the culminating activity. The illustration shows many of the ways electrical energy may be used. From previous discussions and experiences with the *LEARNING ACTIVITIES,* children may conclude that "we use the energy of electricity in many ways."

Learning Activities

1. *HOME USE CHART. Objective:* To consider the use of electricity at home. *Skills:* Gathering data, communicating. *Materials:* One tally sheet per child (see sample included in Series B), catalogs that have pictures of electric appliances, scissors, paste or glue, tagboard.

Send a tally sheet home with each child. Ask the children to talk with their parents about the family's use of electricity and to fill out the tally sheet together. Request that the tally sheets be returned to school. Compare results. How many used lights? TV? Toaster? Refrigerator? Did anyone remember motors on such things as rock tumblers, furnaces, exhaust fans?

This is a good time to discuss what children can do to conserve electricity.

2. *HEAT, LIGHT, MOTION. Objective:* To identify the use of electricity to produce heat, light, and motion. *Skills:* Gathering data, classifying. *Materials:* Catalogs, magazines, scissors, paste or glue, paper on which to make three collages.

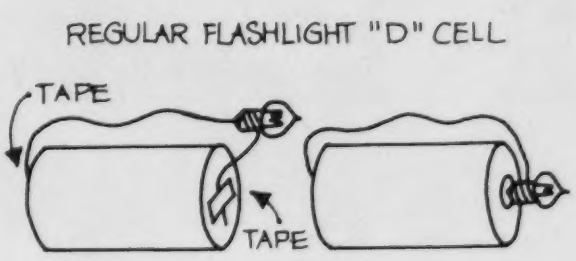
Title three collages: 1) Energy Heats Things; 2) Energy Lights Things; 3) Energy Moves Things. Have the children find pictures that illustrate these ideas. To help them recall the uses of electricity, refer to the tally sheets from activity #1 on this card. Classify items and add to the appropriate collage. If an item does two things (for example, a bulb gives off both heat and light), have the children decide which is the more important.

3. *A FLASH OF LIGHT. Objective:* To recognize that electricity can be turned into light. *Skills:* Designing experiments, communicating. *Materials:* Flashlight battery and bulb, two short pieces of bare copper wire—about 15 cm (6") long, tape, magnifying glass.

Show the class the battery. Explain that there is something stored inside. Does anyone know what? (Energy.) At some point let the children know that what the battery has a little of, a wall plug has a lot of and that electricity should be respected.

How can we use the wire, bulb, and battery to get light? Allow time for children to handle the materials. A bulb can be lighted in either way illustrated. What happens to batteries when we use them a lot? (They lose their energy.)

Use the magnifying glass to observe changes in the bulb.



HOW WE USE ELECTRICITY IN OUR HOME

Listed below are many electrical appliances that we use in our homes. Ask an adult in your family to help you check those items that you use in your home. Make an X beside any appliance that you operate yourself. If your family uses additional items that require electricity, add them to the list.

___ air conditioner
___ bun warmer
___ can opener
___ coffee maker
___ clock
___ clothes dryer
___ dehumidifier
___ dishwasher
___ doorbell
___ fan
___ food processor
___ freezer
___ garage door opener
___ griddle
___ hair dryer
___ hair curler
___ heating pad
___ home movie projector
___ humidifier
___ iron
___ knife
___ lamps
___ mixer
___ mower
___ musical instruments
___ pencil sharpener
___ radio
___ record player
___ regrigerator
___ rug shampooer
___ sandwich grill
___ shoe polisher
___ snowblower
___ space heater
___ stove
___ television
___ toaster
___ toothbrush
___ vacuum cleaner
___ waffle iron
___ warming tray
___ washing machine
___ water softener

Things not on the list:

A MINNESOTA ENERGY ACTIVITY
(Information card to accompany
Card 5 of Series B)

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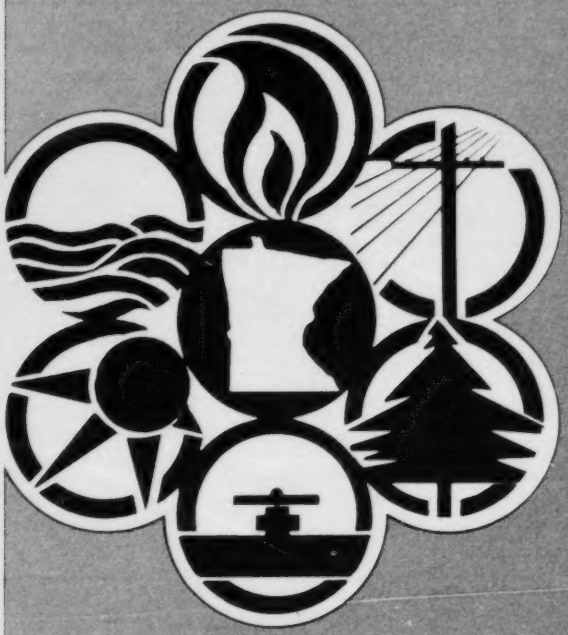


Minnesota Energy Activities

For Elementary Students

Minnesota Department Of Education
Minnesota Energy Agency

LEVEL A for Ages 4-6

WHAT IS ENERGY? WHAT DOES ENERGY DO? WHERE DOES ENERGY COME FROM?

1. Energy is the "go" of things.
2. Our bodies need energy. Energy comes from the food we eat.
3. Energy moves things. The energy to move things comes from many sources.
4. Energy lights things. There are many sources of light.
5. Energy heats things. There are many sources of heat.

LEVEL B for Ages 5-7

WE FIND ENERGY IN MANY PLACES

1. We get energy from the sun.
2. We get energy from the wind.
3. We get energy from water.
4. We get energy from wood, coal, oil, and gas.
5. We use the energy of electricity.

LEVEL C for Ages 6-8

ENERGY DOES ALL THE WORK IN THE WORLD

1-2. Work happens when something moves or changes.
3-4. Energy has to be put into a machine before we can get work out of it.
5-6. People invent machines to do work.
7-8. There are more machines now than in the past.
9. Some of the machines we use today are more important to us than others.
10. In some countries people use fewer machines and less energy than we do.

LEVEL D for Ages 7-9

THE EARTH'S ENERGY SOURCES ARE LIMITED

1-2. Major energy sources in use today are unevenly distributed around the world and must be transported to where they are needed.
3-4. Energy sources are either renewable or nonrenewable.
5-6. Cutting consumption is a way to conserve energy.
7-8. Insulating is a way to conserve energy.
9-10. Recycling is a way to conserve energy.

LEVEL E for Ages 8-10

ENERGY CHANGES FROM ONE FORM TO ANOTHER

1-2. Energy is either waiting (potential energy) or it is working (kinetic energy).
3-4. We use some forms of energy without changing them.
5-6. Energy can be changed (converted) from one form to another to make it more useful.
7-8. There are natural and technological conversion systems.
9-10. Energy is wasted in conversion.

LEVEL F for Ages 9-11

THE ENERGY SITUATION AFFECTS MINNESOTANS TODAY

1-2. Minnesota has special energy problems.
3-4. The cost of energy has an economic impact on families.
5-6. Jobs are dependent on energy availability.
7-8. Energy use has environmental consequences.
9-10. Conservation is everybody's business.

LEVEL G for Ages 10-13

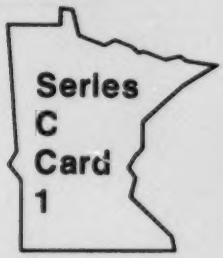
THE ENERGY SITUATION WILL AFFECT THE FUTURE

1-2. Because Minnesota's energy resources are limited, we need to look at alternative sources.
3-4. Alternative energy sources continue to be developed.
5-6. By making use of wastes, we conserve energy.
7-8. The energy situation has an international impact.
9-10. Further advances in energy-related technology will have an impact on our lives that is difficult to imagine.

A Minnesota Energy Activity

Organizing Principle For Series C: Energy does all the work in the world.

Unit 1 Concept: Work happens when something moves or changes.



The Big Idea

Objective: To be aware that when people move or change something they are doing work.

Skills: Classifying, communicating.

Materials: 3-4 cardboard boxes of various sizes (shoebox size and larger), magazines, scissors, paste or glue.

Look through old magazines for pictures of people at work. Choose pictures of children and teens as well as adults at work.

Cut out the pictures and paste them all around the outside of the boxes.

Display the finished boxes in an energy interest center.

Select one picture and tell something about that worker.

What work does the person do?

What does the worker move or change?

Other Learning Activities

Who are the energy workers in our community? (People who assist in the production, distribution, or conservation of energy.) Make a list of the occupations. Then write a class story about one of the workers.

Take turns pantomiming people at work. What is being moved or changed? The person who is able to identify what the worker is moving or changing does the next pantomime.

For the Teacher

Use the photograph and question on the front of this card to begin your discussion of work. Talk about the many ways we use the word "work" (hard work, work as an occupation, work as tasks we do in school). Contrast ideas about work and play. Since both can require considerable energy, are they different? If so, how?

Work happens when something moves or changes in some way. This is the main idea developed by the learning activities on this card. Running, swinging a bat, kicking a ball, closing a door, erasing a chalkboard, and pushing a swing are all examples of work.

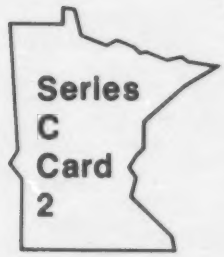
The main activity on this card suggests the use of boxes for displaying pictures of people at work. You could make posters instead, but the boxes add a dimensional aspect to the display which is attention-getting. Separate boxes could be used to depict children, teens, men, and women at work. Place the boxes in an energy interest center. (Card 2 suggests extending the concept by adding pictures of animals to illustrate that living things other than people also do work.)

Whatever the project, have the children work in groups whenever possible. This provides them with an opportunity to develop interpersonal skills and gives you a chance to observe their work habits and how they relate to one another.

A Minnesota Energy Activity

Organizing Principle For Series C: Energy does all the work in the world.

Unit 2 Concept: Work happens when something moves or changes.



What work do animals do?

The Big Idea

Objective: To discover that living things other than people are capable of doing work.

Skills: Observing, communicating.

Materials: Paper, pencils, crayons or watercolor markers, paste, cardboard boxes (see Card 1 of this series of a description of how to make use of the boxes in a display).

Think of an animal you know something about—maybe a pet you have—or an animal you'd like to know about. Observe this animal if you can.

Does this animal move or change anything?

Do animals work?

How do you know?

Draw a picture of this animal doing some work. Paste the picture on a cardboard box and place the box with the other "worker boxes" in your energy interest center.

Other Learning Activities

Look around outside for a place where ants live. You might find some that you can trail to their nest. Observe the ants closely. Put some crumbs near them.

Do ants move anything?

Do ants change anything?

Do ants work?

How do you know?

Read about bees. Observe bees on your own, visit a local beekeeper, or invite a beekeeper to your school.

Draw a picture that shows the work of bees.

For the Teacher

Use the photograph and question on the front of this card to begin your discussion of animals and the work that they do. The main point to bring out is that living things other than people are capable of working. (They are able to move and change things.) Animals—like people—are working when they use energy in play. Whatever the activity, if it moves or changes something, it is work.

Among the things children may have observed about animals at work would be: birds building nests, squirrels burying nuts, guide dogs leading the blind, horses carrying riders, beavers building a dam.

You may want to discuss the work of animals in the circus, on the farm, as performers in TV shows and in commercials and movies.

If it is possible to observe ants outside, the children can leave crumbs from various foods and record the behavior of the ants.

In considering the work of all these living things, you can note whether the work is constructive or destructive for human beings. For instance, honeybees produce food which we eat (constructive) while termites eat their way into wood and can severely damage wooden structures (destructive).

A Minnesota Energy Activity

Organizing Principle For Series C: Energy does all the work in the world.

Unit 3 Concept: Energy has to be put into a machine before we can get work out of it.

Series C Card 3

What makes these machines work?

The Big Idea

Objective: To realize that people are the source of energy for some machines.

Skills: Observing, problem-solving, communicating.

Materials: 4-6 people-powered machines such as a scissors, hammer, can opener, wrench, pliers, brace and bit, screwdriver, stapler, paper cutter, manual typewriter, ditto machine. Also have items on which to put the machines to work—nails, bolts, screws, cans with one end intact, wood scraps, paper.

Learn the name of every tool you have on display in the classroom. These tools are simple machines which we use to do work. Pick out one of the tools and tell all you know about it.

Name the tool.

Tell what it is used for.

Name the worker who would need this tool.

Demonstrate how to use the tool.

Who gives all these tools their "go"? What energy must be put into these simple machines before we get work out of them?

Other Learning Activities

Have someone lie down on a large sheet of paper. Draw all around that person. We can think of our body as a kind of machine. What does our body machine need for energy?

Fill the body outline with pictures of foods. The foods might be classified according to type.

Fill the paper around the body with pictures of work we do with our body energy. Pictures may be cut from magazines or be drawn. Remember that play can be thought of as work, too.

For the Teacher

Use the photograph and question on the front of this card to begin your discussion. Although the children will probably be familiar with many tools, they may not have thought of them as simple machines. Children are fascinated by tools, so try to have several available to handle. (Use adult tools rather than children's tools which are usually inferior in quality and often do not work well.) Stress the proper handling of tools and the necessary safety precautions.

If possible, give each child a chance to try a saw. (Note: Getting the cut started is difficult for children. Starting a cut on a pine board and having the children take turns sawing in one groove saves time.)

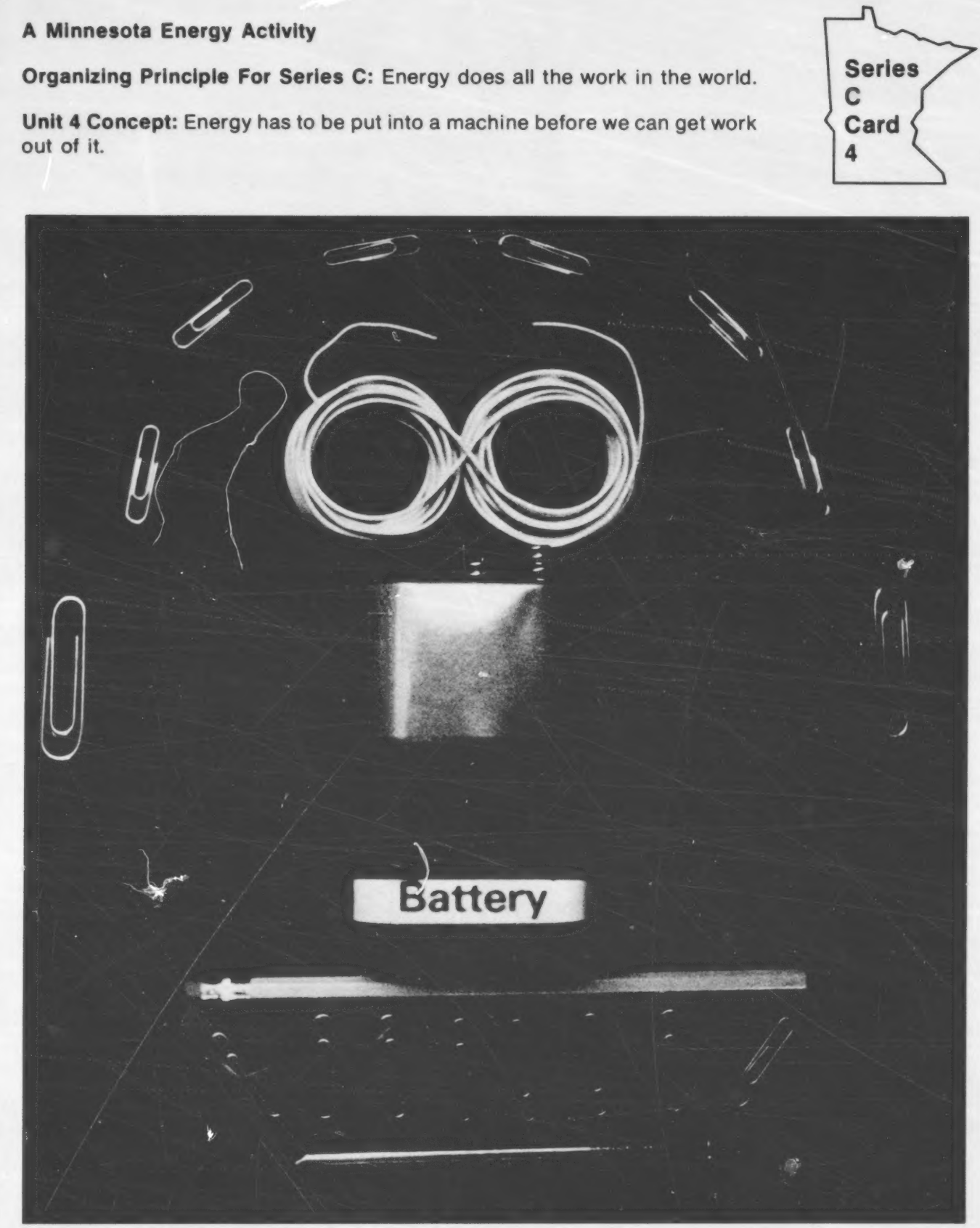
Children can also saw cardboard with a hacksaw blade. Wrap tape around the end of the blade that is to be held. Such a makeshift saw does a good job of cutting cardboard.

Sawing requires a lot of energy. Resulting body changes such as rapid breathing and tiredness can be observed. It may be concluded that we have to put body energy into all hand tools in order to get work out of them.

A Minnesota Energy Activity

Organizing Principle For Series C: Energy does all the work in the world.

Unit 4 Concept: Energy has to be put into a machine before we can get work out of it.



How can you use a battery to make a magnet?

The Big Idea

Objective: To construct a machine that requires electricity as a source of power.

Skills: Designing an experiment, observing, communicating.

Materials: 1 1/2 volt dry cell (or a lantern battery), insulated copper wire (bell wire works and is available in hardware stores), large nail (about 10 cm or 4" long), paring knife.

Take a large nail and touch it to some paper clips. Does the nail have the energy of a magnet?

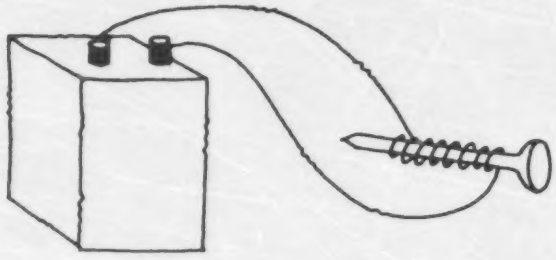
Cut off a 50 cm (20") piece of wire. Scrape off about 3 cm (1") of insulation from each end of the copper wire.

Wrap the wire around the nail about 10 times. Then touch the nail to the paperclips. What happens?

Fasten the bare ends of the wire to the battery terminals and again touch the nail to the paperclips.

Where is the energy coming from to make the nail into a magnet?

What kind of energy is it?



Other Learning Activities

Draw a picture of a machine that uses electricity to make it go. Show your picture to the class. Explain what the machine does and who uses it.

Write a class letter to the electric utility that serves your community. Find out where the electricity for your community is generated and what source of energy is used to produce the electricity.

For the Teacher

Use the photograph and question on the front of this card to begin your discussion of magnets. What are some of the ways magnets are used? (The most visible permanent magnets at home may be in kitchen door latches and decorative hangers used to attach papers to the refrigerator door.)

You may want to introduce the electromagnet activity by first supplying the children with permanent magnets so that they may discover what these magnets will, and will not, do. Unlike permanent magnets, electromagnets lose their magnetism if they do not have a constant flow of energy. Electromagnets are used in situations where magnetism is not needed all the time. One such use is on the end of a crane that lifts scrap metal in a junkyard.

The experiment on this card demonstrates how the electromagnet must have energy put into it in order to get work out of it. You may find that after the electricity is turned off the nail remains slightly magnetized. If it does, you can then show how much less work it will do.

A Minnesota Energy Activity

Organizing Principle For Series C: Energy does all the work in the world.

Unit 5 Concept: People invent machines to do work.

Series C Card 5

How can you make a sled easier to pull?

The Big Idea

Objective: To discover a way to use less energy while moving a heavy load.

Skills: Designing an experiment, communicating.

Materials: Plastic, tub-type sled with a rope handle and one or two skateboards (a pair of clamp-on roller skates can be used instead of a skateboard), spring scale.

Pull an empty sled around the room or outside on a bare sidewalk. Have someone sit in the sled and pull it again.

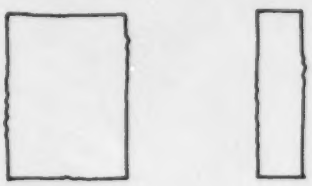
How do you feel when you are pulling a heavy load?

How long could you do such work? For one minute? Two?

Experiment with the sled and the skateboard to find a way to move the sled more easily when someone is sitting in it.

Other Learning Activities

Get scraps of wood that are shaped similar to this.



Float the scraps in a container of water. Find a way to give each piece a little push at the same time. Which board goes the furthest?

What could be done to the boards to make them slide through the water more easily and go further when pushed?

Gather pictures of sports cars, trucks, vans, buses, recreational vehicles. Classify according to the type of vehicle. Discuss the shapes of the vehicles. Why is shape important? What shape does a vehicle have when it is designed to go fast? Why? (Clue: What pushes against your hand if you stick it out a car window while the car is moving?)

For the Teacher

Use the photograph and question on the front of this card to begin your discussion. Talk about the way a sled works on snow. Are there times when sleds do not slide very well? (When snow is wet, the sled sticks to the snow. A sled is also slowed by bare patches.) In much the same way, the sled will "stick" to the sidewalk or classroom floor when someone is sitting in it. To overcome this friction—a term that you need not introduce at this level—we use wheels or rollers.

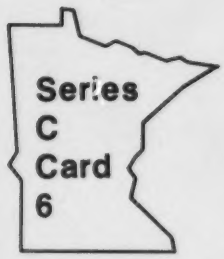
In the experiment, the children should discover through trial and error that the load must be balanced over one skateboard at about the middle of the sled. Two skateboards allow for the making of a sturdier "wagon."

A spring scale will enable students to measure how much "pull" it takes to move the load with and without wheels under it. A bathroom scale might also be used. By placing a bathroom scale against the load and pushing, students can find out how much "push" it takes to move the load.

A Minnesota Energy Activity

Organizing Principle For Series C: Energy does all the work in the world.

Unit 6 Concept: People invent machines to do work.



Could you invent a nutcracker with these materials?

The Big Idea

Objective: To solve a problem by constructing a machine.

Skills: Designing an experiment, evaluating, communicating.

Materials: Lumber scraps, rope or cord—about 2 meters (6'), pulley, brick (or stone about brick size), hammer, pliers, unshelled walnuts.

(This works well as a small team activity.)

The "Crushem Nut Company" is having a contest to find out how many new ways can be devised to crack walnuts. There are three rules in this contest:

1. You cannot crack the walnuts by holding the hammer or pliers or brick or stone in your hand.
2. You can use materials other than those given to you, but you must use the rope and pulley.
3. Winning inventions must crack the shell without crushing the nut inside!

Other Learning Activities

Use your imagination as you construct a machine out of building materials such as Legos or Tinker Toys.

What work could your machine do?

What is the source of energy for your machine?

Draw a picture that shows three ways you could travel to a store near your home.

Which way do you travel to the store most often?

Which way of getting to the store uses the least energy?

Invite an inventor to visit your classroom and share ideas about energy and inventions.

For the Teacher

Use the photograph and question on the front of this card to begin your discussion. You may want to talk about the way people get ideas. For example, the inventor of the shopping cart saw people carrying shopping baskets and thought there must be an easier way to haul all that weight around the store. So he put two old ideas together—the basket and the wheel—and invented the first shopping cart.

Inventions frequently come about because people are seeking ways to use less of their own energy to do a particular task. The new inventions are often meldings or refinements of old ideas. Encouraging children to look for ingenious solutions helps prepare them for an uncertain energy future in which their ideas may be most useful.

Adult inventors are looking anew at the wind, the sun, and the earth. More efficient windmills and solar collectors are being designed. Sod houses were a part of Minnesota's past, and earth-sheltered buildings are becoming more important in today's world.

A Minnesota Energy Activity

Organizing Principle For Series C: Energy does all the work in the world.

Unit 7 Concept: There are more machines now than in the past.

How were energy and machines used in the past?

The Big Idea

Objective: To discover that today we use more machines to do our work than people used in the past.

Skills: Communicating, gathering and analyzing data.

Materials: Paper, pencil, tape recorder. Although a tape recorder is not essential, it adds a special dimension to this activity and is useful in practicing interviewing skills. The actual interview can become part of an energy interest center.

Arrange an interview with someone who lived in the early 1900s. Prepare a list of questions about the use of machines and energy long ago. See what you can discover about machines people used for:

Heating,
Cleaning,
Recreation,
Cooking,
Lighting,
Transportation.

What machines did people use in the past that we still use today? How have the machines changed? What machines do we have today that people who lived long ago didn't have?

Other Learning Activities

Visit your county and/or state historical society or a museum. Look especially for machines that people used to help them do their work.

Make a "then" and "now" mural. Draw or paint pictures of people doing work when much of the energy to get work done came from their own bodies. Draw or paint pictures of people and the machines we use to get that same work done today.

For the Teacher

Use the photograph and question on the front of this card to begin your discussion of energy and machines. See if anyone has a relative who might talk to the class about energy and the kinds of machines people used in the early 1900s. Many older people in the community would enjoy such sharing, but they need an invitation. If the person cannot come to the school, arrange a field trip. People in nursing homes are usually delighted to be visited by children.

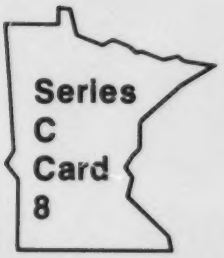
Prior to the interview, the children should discuss how to prepare for and conduct interviews. (Should questions be listed? Who gets to ask them? How much time is needed?) Have practice sessions. A tape recorder helps children improve their interviewing skills. Taping the actual interview gives you a resource for your energy interest center. Children should be able to conclude from the information gathered that we have more machines to help us with our work today than people had in the past.

Old magazines, catalogs, and newspapers are rich sources for finding out what life was like in the past. These materials can be found in a public or historical society library.

A Minnesota Energy Activity

Organizing Principle For Series C: Energy does all the work in the world.

Unit 8 Concept: There are more machines now than in the past.



What will this machine do?

The Big Idea

Objective: To use body energy to do work which is often done with a machine that uses another form of energy.

Skills: Observing, communicating.

Materials: Manually operated egg beater, mixing bowl, pint of whipping cream, ¼ cup sugar for sweetening if desired, spoons for tasting.

Examine an egg beater and learn how to operate it. Then pour cream in the bowl and use the egg beater to whip it. You must keep on turning the beater very fast. Watch for changes in the cream, but keep on whipping.

Why is it called whipping cream?

How can you tell when it is whipped enough?

Add sugar if sweetening is desired, and let everyone have a taste.

Where did the energy to work the beater come from?

Do you have another kind of beater at home? If you do, where does the energy to work it come from?

Other Learning Activities

If there is a creamery in your community, arrange for a field trip to discover how cream is turned into butter today. Find out how butter was made before there were creameries.

Imagine that for one day you cannot use any energy other than what you get from your own body.

How would you travel to a friend's house a mile away?

How would you wash your socks if you needed a clean pair?

What would you do instead of watching TV?

What would you eat?

If it was very hot, how would you cool yourself?

If it was very cold, how woul you keep warm?

For the Teacher

Use the photograph and question on the front of this card to begin your discussion. Establish that the machine is called an egg beater. Talk about the different things this machine might be used to do besides beat eggs.

Making whipped cream with the beater is fun, but don't let the fun obscure the point. When the work is completed, the children should be aware that they have used body energy to do work that is commonly done with an appliance which consumes electrical energy. Ask them to think of other machines we use at home or in school that are powered by body energy.

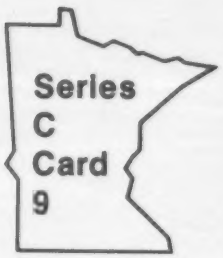
You may want to make a chart that contrasts body-powered machines with their counterparts that are powered by another form of energy. Examples:

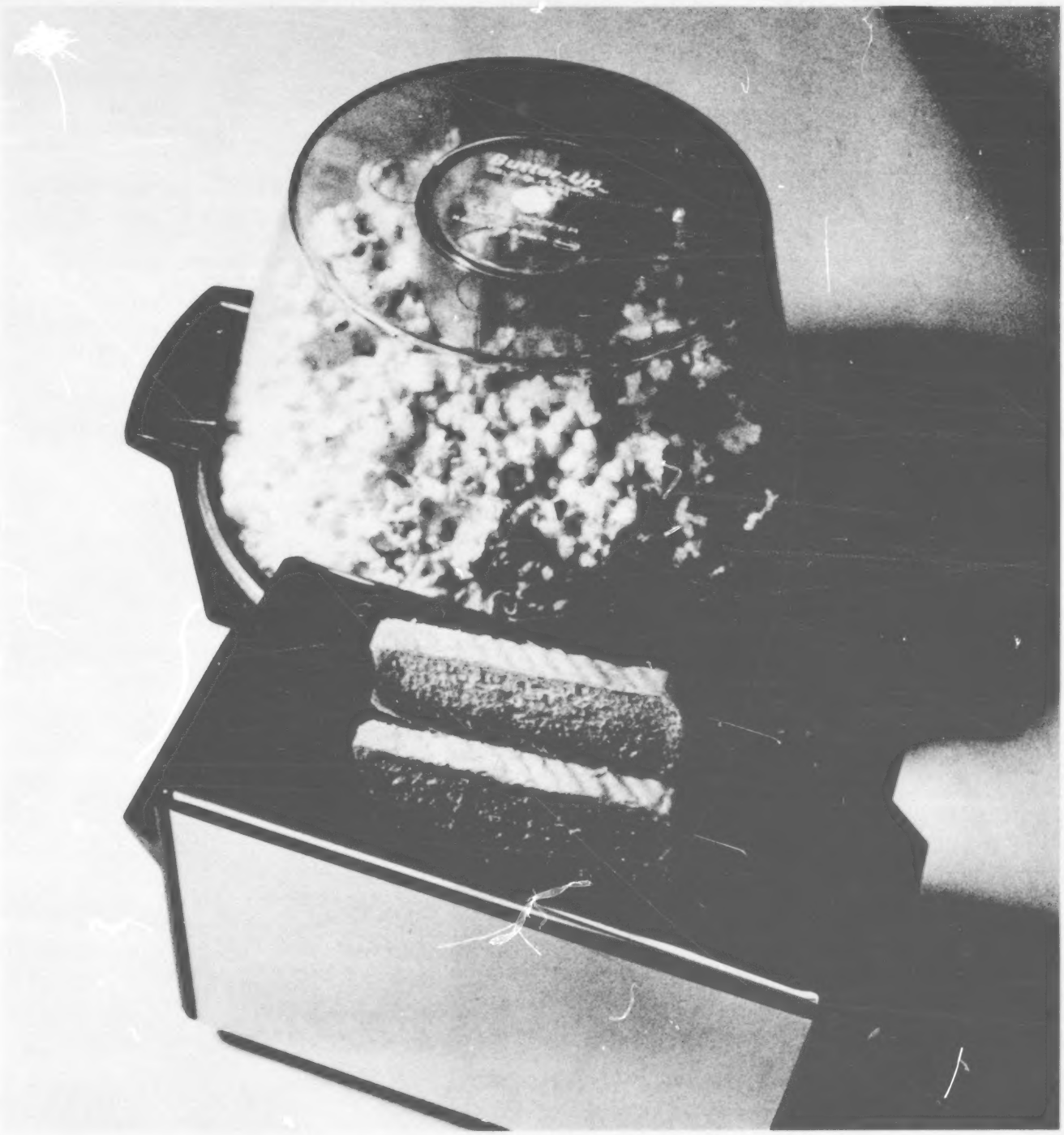
snow shovel—snowblower
washboard—washing machine
reel-type mower—self-propelled mower
hands—milking machine
toothbrush—electric toothbrush.

A Minnesota Energy Activity

Organizing Principle For Series C: Energy does all the work in the world.

Unit 9 Concept: Some of the machines we use today are more important to us than others.





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Which is more important to you—a popcorn popper or a toaster?

The Big Idea

Objective: To make personal judgments about our use of energy.

Skills: Classifying, evaluating, communicating.

Materials: Pencil and paper for each person taking part, chalkboard and chalk.

One person may value a popcorn popper while another values the toaster. Neither is "right" nor "wrong." It is simply a matter of personal preference.

Brainstorm to think of all the ways you use electrical energy at home. List them on the chalkboard.

Each person taking part now needs a sheet of paper and a pencil. Make a star on one side of the paper and a frowning face on the other.

On the star side, list or draw the three uses of electricity that are *most* important to you.

On the face side, list or draw the three uses of electricity that are *least* important to you.

Meet in small groups and choose a group leader. Share star choices. Then the group must decide what it considers to be the three most important uses of electricity. Do the same for the least important uses. Groups share what they believe to be the most and least important uses with the class.

Other Learning Activities

Take individual papers home and share them with your families. Ask parents and other family members to try this activity.

List things people do for recreation. Then make a chart that shows the forms of energy used for each activity.

How does a gasoline shortage affect recreation?

What would happen if we could use no electricity for recreation?

What forms of recreation help conserve energy?

Role play a situation in which a family is making plans for a vacation. One person is to be very concerned about energy conservation.

For the Teacher

Use the photograph and question on the front of this card to begin the values activity. Much of the benefit of the activity comes in the small group meetings. There the children will be challenged to give reasons for their choices. If they want their choices for most and least important uses of electricity to be adopted by the group, they will have to be logical and persuasive.

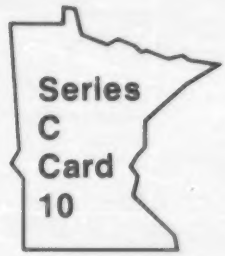
This activity is most valuable if the small groups have the opportunity to share their final choices with the entire class and end with a discussion.

Exposure to diversity of thought makes children aware of how difficult it is to make choices as a group. This difficulty extends through local, state, and national organizations that have to make decisions relative to the energy situation. Watch for newspaper articles that describe choices to be made.

A Minnesota Energy Activity

Organizing Principle For Series C: Energy does all the work in the world.

Unit 10 Concept: In some countries people use fewer machines and less energy than we do.



What is it like to live without many machines?

The Big Idea

Objective: To be aware of energy use in another country.

Skills: Analyzing, evaluating, communicating.

Materials: Drawing paper, crayons.

We Americans tend to use a lot of machines in our homes. The machines range from toasters and mixers to stoves and refrigerators.

Have you ever gone camping and left most of your appliances behind? If you haven't camped out, can you imagine what it is like to live in a tent and have no built-in electricity or running water?

How would you cook?

What would you use for lights?

How would you bathe?

What would be your recreation?

In many countries of the world people live without conveniences that we think of as necessities. Read "A Way that Others Live,"* the story of Arun and Mutu who live in a village in northern India.

For the Teacher

Use the photograph and question on the front of this card to begin your discussion of what it is like to live without a lot of appliances and conveniences that we take for granted in our daily living. Use this as a lead-in to a discussion of how people in other parts of the world have lifestyles that require far less energy than we use. On this card, we are considering India.

India is a land of contrasts. It has cities that appear as modern as those in our country, but it also has rural villages where life by our standards is primitive.

Locate India on a globe to give the children a sense of its relationship to where they live. Share information about India. Then read the story.

As a follow-up you may want to:

1. Discuss the story, paying attention to likenesses and differences between the life of Arun and Mutu and life in your community.

2. Draw contrast pictures. Fold a large sheet of paper in half. On the left, draw pictures of things Arun or Mutu do. On the right, draw pictures showing how we do the same activities. What activities do they do that we don't? What do we do that they don't? What are the advantages and disadvantages of each? What can we say about the use of energy in each community?

3. Read books and the encyclopedia entry for "India." Look especially for pictures in which you can identify specific uses of energy.

*See the "Information Card" which accompanies this series.

INFORMATION CARD

A Way that Others Live

Arun and his twin sister, Mutu, live in the northern part of India. India is a very large country. It has big cities, but many people live in villages where life is very different from the way we live. The house Arun and Mutu live in is built beside a lake. Some people in their village live on the lake in houseboats.

Arun and Mutu have no running water in their house. They use lake water for washing themselves and their clothes. Mutu goes to a village well to get water for drinking and cooking. She carries the water in a jar which she balances on her head.

The school Arun and Mutu go to is across the lake from their house. To get to school, they take the family boat which is called a "shikara." They paddle the boat across the water.

After school, Arun and his sister have chores to do. Mutu sweeps the floor of their house with a straw broom and helps do the cooking. All the meals are cooked on a stove that burns wood.

Mutu and Arun take turns gathering wood for the fire. Sometimes Arun helps with the cooking, but the job he likes best is fishing for the family's dinner. His fishpole is a stick with a line tied to one end.

A meal of fish and rice is a favorite with Arun and Mutu. The family grows some rice. They buy such things as melons and bananas in the village market. And they buy vegetables from people on the vegetable boat that floats past their house once a week.

Life is not all work for Arun and Mutu. They play tag and other running games. Arun and his friends especially like the game of marbles which they play with small stones.

There is no electricity in the village, so Arun and Mutu do their homework before it gets dark. When the day's work is done, one of their favorite pastimes is listening to stories. Young people and old people, too, gather around the storyteller. They enjoy Indian history, fairy tales, or long poems about gods and goddesses.

On holidays, Arun and Mutu get a special treat. Their father takes them for a ride on a two-wheeled cart called a "tonga." The tonga is like a taxi pulled by a horse.

One day Arun and Mutu may move to a large city in India. They would find that wherever people make their home they have their own way of life.

-end-

A MINNESOTA ENERGY ACTIVITY (Information card to accompany Card 10 of Series C)

Minnesota Energy Activities

For Elementary Students

Minnesota Department Of Education
Minnesota Energy Agency

LEVEL A for Ages 4-6

WHAT IS ENERGY? WHAT DOES ENERGY DO? WHERE DOES ENERGY COME FROM?

1. Energy is the "go" of things.
2. Our bodies need energy. Energy comes from the food we eat.
3. Energy moves things. The energy to move things comes from many sources.
4. Energy lights things. There are many sources of light.
5. Energy heats things. There are many sources of heat.

LEVEL B for Ages 5-7

WE FIND ENERGY IN MANY PLACES

1. We get energy from the sun.
2. We get energy from the wind.
3. We get energy from water.
4. We get energy from wood, coal, oil, and gas.
5. We use the energy of electricity.

LEVEL C for Ages 6-8

ENERGY DOES ALL THE WORK IN THE WORLD

1-2. Work happens when something moves or changes.
3-4. Energy has to be put into a machine before we can get work out of it.
5-6. People invent machines to do work.
7-8. There are more machines now than in the past.
9. Some of the machines we use today are more important to us than others.
10. In some countries people use fewer machines and less energy than we do.

LEVEL D for Ages 7-9

THE EARTH'S ENERGY SOURCES ARE LIMITED

1-2. Major energy sources in use today are unevenly distributed around the world and must be transported to where they are needed.
3-4. Energy sources are either renewable or nonrenewable.
5-6. Cutting consumption is a way to conserve energy.
7-8. Insulating is a way to conserve energy.
9-10. Recycling is a way to conserve energy.

LEVEL E for Ages 8-10

ENERGY CHANGES FROM ONE FORM TO ANOTHER

1-2. Energy is either waiting (potential energy) or it is working (kinetic energy).
3-4. We use some forms of energy without changing them.
5-6. Energy can be changed (converted) from one form to another to make it more useful.
7-8. There are natural and technological conversion systems.
9-10. Energy is wasted in conversion.

LEVEL F for Ages 9-11

THE ENERGY SITUATION AFFECTS MINNESOTANS TODAY

1-2. Minnesota has special energy problems.
3-4. The cost of energy has an economic impact on families.
5-6. Jobs are dependent on energy availability.
7-8. Energy use has environmental consequences.
9-10. Conservation is everybody's business.

LEVEL G for Ages 10-13

THE ENERGY SITUATION WILL AFFECT THE FUTURE

1-2. Because Minnesota's energy resources are limited, we need to look at alternative sources.
3-4. Alternative energy sources continue to be developed.
5-6. By making use of wastes, we conserve energy.
7-8. The energy situation has an international impact.
9-10. Further advances in energy-related technology will have an impact on our lives that is difficult to imagine.

A Minnesota Energy Activity

Organizing Principle For Series D: The earth's energy sources are limited.

Unit 1 Concept: Major energy sources in use today are unevenly distributed around the world and must be transported to where they are needed.

Where in the world do we find oil? Coal? Natural gas?

The Big Idea

Objective: To locate energy sources in various parts of the world.

Skills: Gathering and analyzing data, communicating.

Materials: Crayons, construction paper, globe or map of the world, tape.

Create individual symbols for oil, coal, and natural gas. Use crayons and construction paper. Make the symbols a size that will fit your world map or globe.

Divide into three groups. Have one group research oil (petroleum), one coal, the other natural gas. Use encyclopedias and any other available materials to find out where these sources of energy are located.

Place symbols on the globe or world map to indicate the location of these energy sources.

Other Learning Activities

What fuel do people in your community use for heating homes and other buildings? To find out, take a survey.

Then make a graph to show the results.

What part of the world might these fuels come from?

Select a country other than the United States and do some research to find out what life is like in that country.

Locate the country on the world map or globe.

What are the sources of energy for that country?

Draw pictures and make a booklet that tells about life in the country you have chosen.

How is life there similar to life in the United States?

How is life there different?

What does this tell you about that country's use of energy

For the Teacher

Use the photograph and question on the front of this card to begin your discussion about the location of energy sources. Although the children may have some knowledge of energy sources around the world, your discussion will probably reveal that they know only a little about the subject.

Research and subsequent preparation of a map showing the location of the world's energy resources will make it clear that long distances separate Minnesota from major sources of the fossil fuels, oil, coal, and natural gas. Our state is dependent on other states and other nations for these forms of energy.

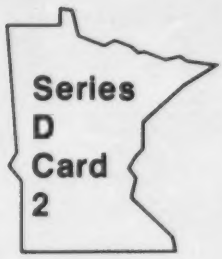
Be on the alert for news stories about the transporting of fossil fuels to meet Minnesota's energy needs.

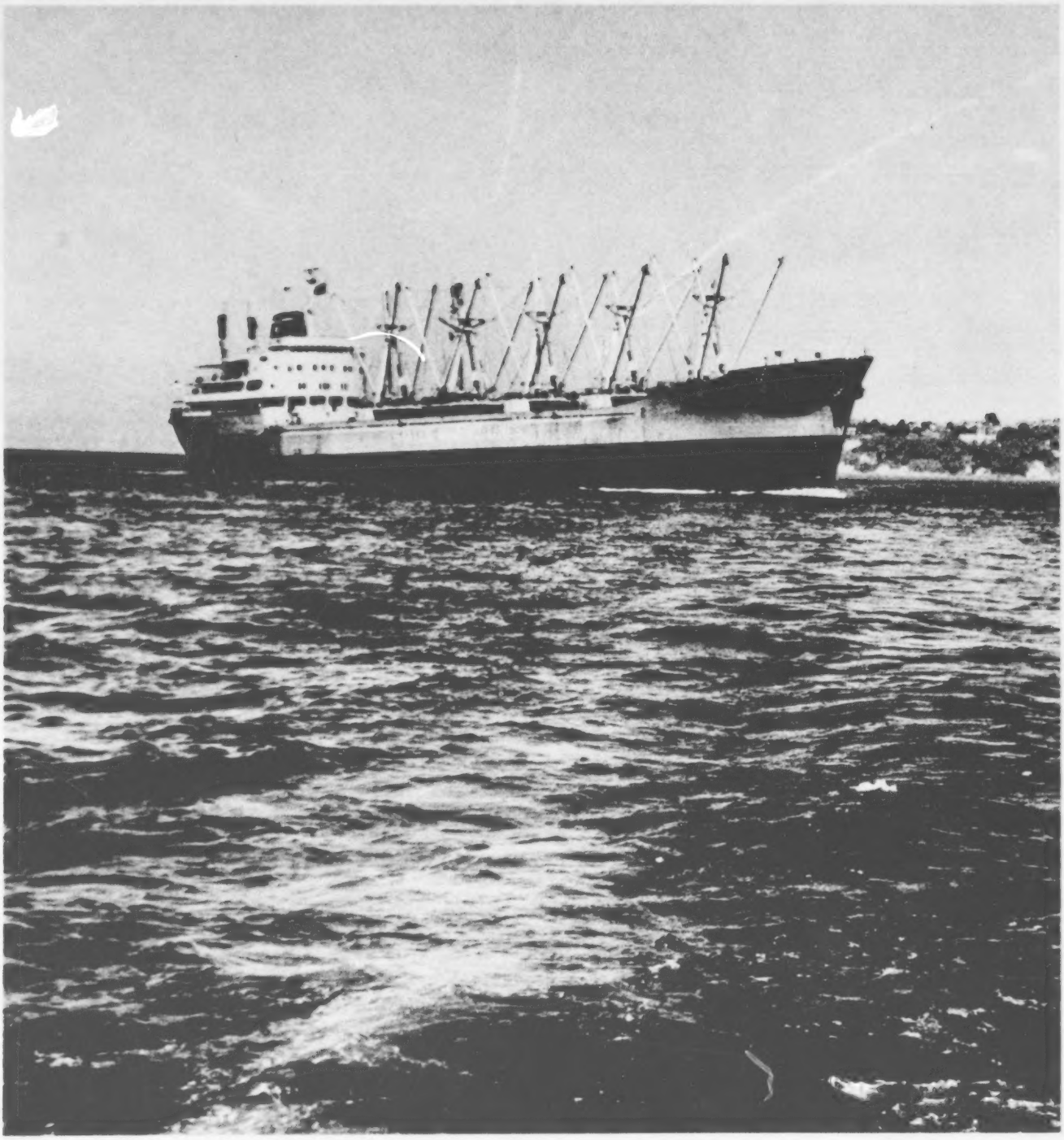
In evaluating the energy map with the children, consider which nations or regions appear to be "energy rich" and which appear to be "energy poor." How does a nation's being energy rich or poor affect life in that country?

A Minnesota Energy Activity

Organizing Principle For Series D: The earth's energy sources are limited.

Unit 2 Concept: Major energy sources in use today are unevenly distributed around the world and must be transported to where they are needed.





How is oil cleaned up when it gets spilled on water?

The Big Idea

Objective: To understand that problems occur in the transportation of fossil fuels.

Skills: Designing an experiment, predicting, evaluating, communicating.

Materials: Small quantity of oil (dark engine oil is best but cooking oil will also work), shallow containers of water, paper towels, cotton balls, detergent, eyedroppers.

Divide into teams and provide each team with similar materials for a "cleanup contest." Whenever there is an oil spill on water, time becomes a critical factor. The faster the oil can be cleaned up, the less the environment is damaged. Decide on rules for your contest. You may want to judge on the basis of how fast or how well the oil is removed. Place a few drops of oil in each container of water. Have teams compete in cleaning up the spills.

What seems to be the easiest way to get oil out of water? The hardest way?

From what you've discovered, can you think of other methods that might be used to clean up an oil spill? (Set up an experiment to test ideas.)

Other Learning Activities

Collect newspaper and magazine articles about fuel spills. Share them with the class. Then display them on a bulletin board or in your energy interest center.

Investigate tankers and give a report to the class.

What is a supertanker?

How do they carry oil?

Where can they load and unload?

What advantages and disadvantages are there to supertankers?

Find out how coal is mined and transported.

How does the mining and transporting of coal affect the environment?

For the Teacher

Use the photograph and question on the front of this card to begin your discussion of oil spills and the problems they create. What causes them? (Pipeline ruptures, shipping accidents at sea, tanker truck accidents, etc.) Why are oil spills harmful? (Kill wildlife, waste a resource, pollute.)

Oil spilled at sea may drift for many miles. Attempts may be made to contain the spill with booms, suck it up, absorb it with absorbent materials, burn it, or break it down with chemicals. Many spills go untreated and in time the ocean breaks down the oil. On land, spills are diked if possible and as much oil as can be collected is salvaged. In some cases, fuel spills in porous soil are pumped out like water from a well. It may be years, however, before total damage is known, since oil can leach into the water supply.

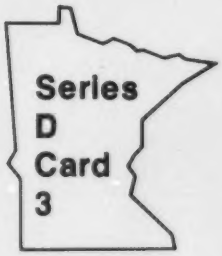
If you prefer not to have a contest, simply test and rate materials according to their ability to separate oil from water. Provide additional materials such as rags, Styrofoam, and straw for testing. Removing the pressure of competition allows time for a systematic gathering of information and charting of data.

In carrying out the energy activities, have the children work in groups whenever possible. This gives them the opportunity to develop interpersonal skills and gives you a chance to stand back and observe their work habits and how they relate to one another.

A Minnesota Energy Activity

Organizing Principle For Series D: The earth's energy sources are limited.

Unit 3 Concept: Energy sources are either renewable or non-renewable.



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Why is wood a "renewable" source of energy?

The Big Idea

Objective: To understand that some of our energy sources are renewable.

Skills: Designing an experiment, observing, measuring, inferring.

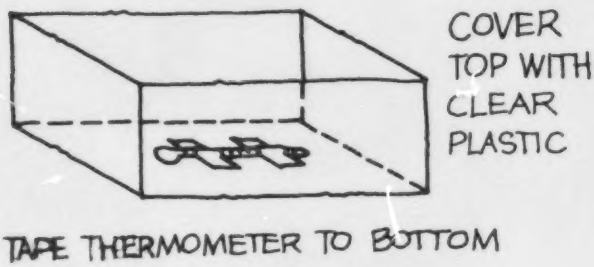
Materials: Shoebox, plastic wrap, cellophane tape, thermometer.

Construct a sunhouse to discover how useful the sun is as a source of heat. Use cellophane tape to fasten a thermometer inside a small box such as a shoebox. Record the temperature on the thermometer. Then place your sunhouse in the sun. Record the temperature every five minutes for one-half hour.

How do you explain what happens?

What, if anything, could be done to raise the temperature?

What problems are there in trying to use the sun as a source of energy for home heating in Minnesota?



Other Learning Activities

Create a device that will tell you something about the wind. Hang pieces of string from a meterstick. Tie objects of various weights to the strings—stone, feather, stick. Hang the device where it will catch the wind.

Do all the objects move in the wind?

What can you learn about the wind from this device?

For the Teacher

Use the photograph and question on the front of this card to begin your discussion of renewable sources of energy. (Non-renewable sources are covered on Card 4.) Discuss the various uses of firewood. (For light and heat, for smoking and preserving meat and fish, etc.)

Read "Energy Sources for the Future"* to the children or have them read it individually. It's important at this point that they understand the difference between renewable and non-renewable energy sources. The distinction can be confusing because "exhaustible" and "inexhaustible" are terms which are sometimes used.

Whatever the terms, labeling energy sources is difficult. We consider the sun renewable because it has such a long life in human terms, but the sun will burn out someday. Although wood is considered to be a renewable energy source, without ongoing conservation a forest can be depleted. It takes years for such a forest to become productive again. In parts of the world, the land has been so stripped of trees that for practical purposes this resource has been exhausted.

Increasingly, Minnesotans are turning to wood as an energy source. Even though Minnesota has millions of acres of forest land, we must balance planting with harvesting if wood is to be an energy resource for the future.

*See the "Information Card" which accompanies this series.

INFORMATION CARD

Energy Sources for the Future

What would grow if you planted seeds from an elm tree, some lumps of coal, and a few drops of oil? The coal would not grow and neither would the oil. But if conditions were right, the elm seeds would grow into more trees. These trees could be cut down and be burned or used in another way.

Because a tree seed will grow into another tree that we can use for wood, we call wood a "renewable" source of energy. If we use the trees in our forests wisely, we will always have wood as a source of energy. To insure that we will continue to have wood, we must plant as well as harvest trees.

What about wind and the running water of rivers and ocean tides? Can we use their energy again and again without destroying them? Yes, we can, so these sources of energy are also called renewable.

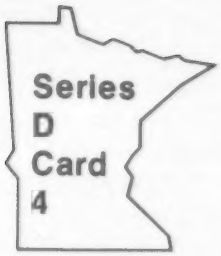
Our most important source of energy is the sun. We can use its energy day after day after day. Since we can't use up the sun, it is a renewable source of energy. The sun is an important source of energy for us now and will be even more important in the future.

A MINNESOTA ENERGY ACTIVITY
(Information card to accompany
Card 3 of Series D)

A Minnesota Energy Activity

Organizing Principle For Series D: The earth's energy sources are limited.

Unit 4 Concept: Energy sources are either renewable or non-renewable.



Why is a candle a "non-renewable" source of energy?

The Big Idea

Objective: To become aware that our most commonly used sources of energy—the fossil fuels, coal, oil, and natural gas—are non-renewable and are running out.

Skills: Observing, communicating.

Materials: 2-3 birthday candles, matches, metal spoon, piece of aluminum foil or a dish on which to place a candle for burning.

Set up a birthday candle so that it can be burned safely. (Have an adult helper.) Wax for many of the candles we use is made from oil which is a fossil fuel. Observe the candle as it burns.

What happens to the wax and the wick?
What is going into the air?

(Place a spoon over the flame and see if anything forms on the spoon.)

Other Learning Activities

Imagine that there is only enough gasoline at the station to fill three tanks. The month's allocation has been used and there won't be any more gas for a week. Six drivers want the gas that is available.

The fire department needs gas for the fire truck.
A family going on vacation needs gas for their yearly trip.
A farmer needs gas to take the pigs to market.
A snowmobile driver needs gas for a big race.
A basketball team needs gas to reach the state tournament.
A plumber needs gas to make all emergency calls.
Who will get the gas?

For the Teacher

Use the photograph and question on the front of this card to begin your discussion of non-renewable sources of energy. Children who have worked with the ideas on Card 3 may already be able to distinguish between renewable and non-renewable. Read "What Energy Sources Do We Use the Most?"* to the class or have the children read it individually.

After information has been shared, burn a candle and observe. (Although the candle "burns up," the energy has not been burned up. Energy is never destroyed—it only changes form. Observation of the burning candle reveals that it is changing into heat and light. It is also giving off pollutants. The candle symbolizes all non-renewable energy sources.)

We want to alert children to the fact that fossil fuel reserves are limited, but we don't want to frighten them. Being alert to our energy situation motivates us to conserve. This extends supplies, giving us time to develop alternative sources and change our energy-consuming habits.

*See "Information Card" which accompanies this series.

INFORMATION CARD

What Energy Sources Do We Use the Most?

Almost all the energy we use comes from "fossil fuels." Fossil fuels are found in the ground. They are oil, coal, and natural gas. These energy sources are called "non-renewable" because we can use them up. (The world's climatic conditions aren't likely to be such that these fossil fuels can be formed again.)

No one knows exactly how much fossil fuel there is in the earth. So we don't know how long it will be before we have used up these energy resources. But there is one thing we do know—a time will come when the fossil fuels that are left will be increasingly expensive and not be available to many people. Eventually, this source of energy will be a thing of the past.

We use fossil fuels in many ways today. They provide most of our heat and light. They run our cars and jets and trains. Fossil fuels have other uses, too. Paint, plastic, fertilizer, and nylon are just a few of the things that can be made from oil and coal.

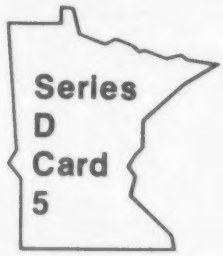
Our non-renewable energy sources will last for quite a few years. But as they become more scarce, they will also become more expensive. Now that we know we will run out of fossil fuels one day, it's important that we make wise use of what we have left.

A MINNESOTA ENERGY ACTIVITIY
(Information card to accompany
Card 4 of Series D)

A Minnesota Energy Activity

Organizing Principle For Series D: The earth's energy sources are limited.

Unit 5 Concept: Cutting consumption is a way to conserve energy.



What happens if you leave the refrigerator door open for a long time?

The Big Idea

Objective: To recognize that every person can do something to conserve energy.

Skills: Classifying, evaluating.

Materials: Pencils and writing paper.

List all the ways you can think of that you use energy during a week. (Clue: Think of one day from morning to night.)

Put a star next to five important things on your list that you want to continue using energy to do.

Next pick out one of the things on the list you could give up for a week. Draw a line under it.

Make an energy-saving contract with yourself. (This is the contract one person wrote: "For one week I will ride my bike to my friend's house instead of asking for a ride in the car.")

After one week, review your contract. What have you learned about conserving energy?

Other Learning Activities

Plan, write, and—if possible—record 30-second radio commercials that encourage conservation. Play them for children in another grade.

Compose a class letter to parents. Invite parents to hold family mealtime energy conferences during a given week. Develop the letter around the idea that saving energy saves money—or an idea of your own. Reproduce the letters and send them home. Later, have a class discussion in which you share ideas developed at home.

For the Teacher

Use the photograph and question on the front of this card to begin your discussion on energy conservation. You may want to make the point that becoming conscious of our wasteful habits is a first step each of us can take in becoming "energy aware."

In becoming energy aware, we recognize the need to conserve. Brainstorm for positive solutions to wasteful habits. For example, looking into the refrigerator too long can be solved by having a list of treats on the door. Making a choice before opening the door saves energy.

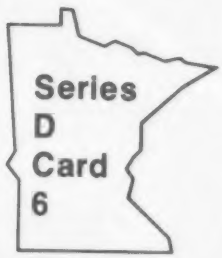
Extending energy awareness to school life is also important. Children can be encouraged to hold the outside door open as little as possible during the heating or cooling season, to turn off unneeded lights, and conserve water. Learning to save on purpose not only extends present resources but also creates the feeling that we are part of the solution instead of the problem!

In making a contract, it's important that a child be specific. A contract that says, "I will save energy," is much too general. Also, a contract should have a time limit long enough to accomplish the goal but not so long that the child loses interest. A week is usually a good time span. Depending upon the contract, it's sometimes helpful to have goals for what is to be accomplished on the first day, the second, and so on. After a week, review the contract. Then it can be terminated, extended, or rewritten.

A Minnesota Energy Activity

Organizing Principle For Series D: The earth's energy sources are limited.

Unit 6 Concept: Cutting consumption is a way to conserve energy.



How does wasting less of everything save energy?

The Big Idea

Objective: To realize that there is a relationship between "waste" and energy consumption.

Skills: Predicting, communicating.

Materials: Plastic dropcloth or newspapers on which wastebasket contents can be dumped, scale.

Work out a plan to estimate how much the trash weighs that is thrown away each week:

by your class,
by your school,
by your family at home.

Other Learning Activities

Make a wastebasket check in your classroom. Try predicting how many pieces of trash there will be. Count, sort, and classify the contents of the wastebasket. What things were thrown away that were still useful.

How do we decide when to throw things away?

We all have different tastes in food. In school cafeterias where everyone gets served the same menu, much food gets thrown away. Develop a way to find out what foods students like the most and which they like the least.

How can you find out if second and fourth graders have the same likes and dislikes?

How can you find out if servings are too large or too small?

How can you get ideas from students about ways to waste less food?

Create a menu that is both nutritious and satisfying to students.

For the Teacher

Use the photograph and question on the front of this card to begin your discussion of waste and its relationship to energy consumption. In the past, the various sources of energy were relatively cheap and readily obtainable. It seemed to be of little consequence that every manufactured product—from breakfast cereal to cars—required energy to produce. However, since the 1973 oil embargo, energy has become a national concern. It is now critical that we consider how we can conserve by using less of all consumer goods. Cutting back on the direct consumption of gasoline and other fuels is important, but cutting back on all consumption by limiting waste is also essential.

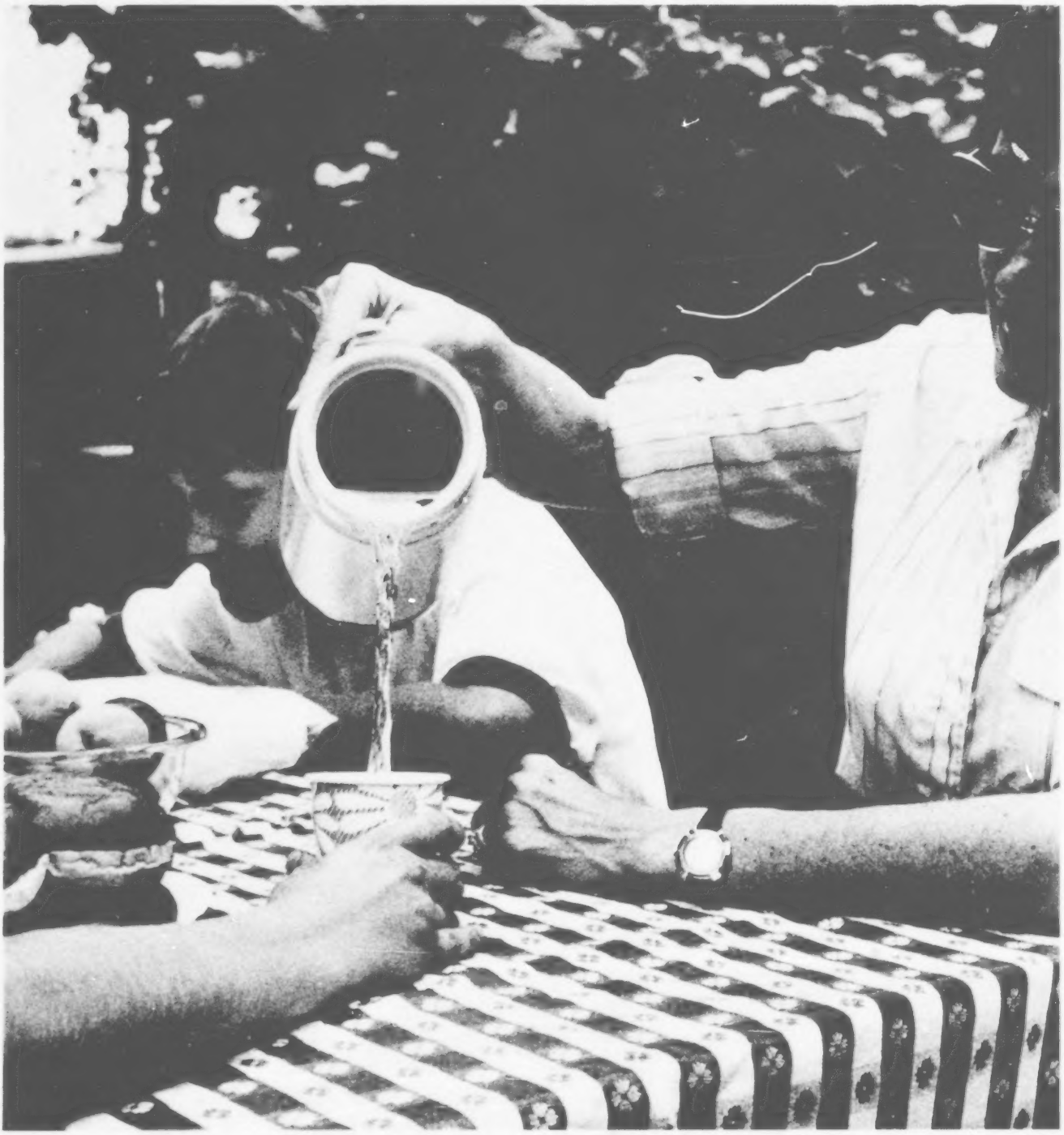
Children can look at their own habits and discover ways in which they waste without meaning to. Paper is thrown away after only one side has been used. Pencils, crayons, and erasers are often discarded while still useful. In the lunchroom, children throw away foods they don't care for. The activities suggested on this card are intended to make children aware of waste and encourage them to begin correcting wasteful habits.

Keep in mind that going through someone else's trash is an invasion of privacy. If a wastebasket check is to be made in a room other than your own, have the permission of that classroom teacher.

A Minnesota Energy Activity

Organizing Principle For Series D: The earth's energy sources are limited.

Unit 7 Concept: Insulating is a way to conserve energy.



Why does a thermos bottle keep hot things hot and cold things cold?

The Big Idea

Objective: To be aware of ways in which insulation is used.

Skills: Designing an experiment, predicting, measuring.

Materials: Large-mouth thermos bottle, tin can, measuring cup, hot water, thermometer.

Pour an equal amount of hot water in a thermos bottle and a tin cup. Measure and record the temperature of the water in each container. (Leave the top off the thermos.)

Measure and record the temperature every ten minutes. Do this three times.

What happens to the water in each container?

Predict what would happen if you did the experiment with ice cold water. Then try it and see what happens.

Will putting the top on the thermos make a difference?

How could you improve a thermos bottle?

Other Learning Activities

Invite someone in the building trade to your classroom. Ask this person to bring samples and tell you about various uses of insulation. Be ready with questions.

Find out all you can about hypothermia. (Perhaps your school nurse can help you.)

Set up a clothing display that illustrates ways we insulate our bodies in cold weather. Check labels to find out what materials each item is made from.

Why do layers of clothing help insulate against the cold?

Why is a down jacket a good insulator?

It is a cold, windy day and you have tickets to a football game. Your tickets are for bleacher seats that are out in the open.

What will you do to insulate yourself against the cold?

For the Teacher

Use the photograph and question on the front of this card to begin your discussion of insulation. If possible, have a thermos bottle on hand that can be taken apart. (Handle the glass liner with care.) Discuss how the thermos is constructed. (The thermos or vacuum bottle is a bottle inside a bottle with a vacuum between the layers of glass. The vacuum, and the glass, slow the transfer of heat. The silver surface reflects heat rather like a mirror reflects light.)

Insulation in the form of a vacuum, fiberglass, or any other poor conductor, is used where we want to prevent the transfer of heat, sound, or electricity. The type of insulation that comes to mind most readily is home insulation. Many children will have heard about its importance in cutting heating costs. Having a speaker discuss insulation and display various kinds of materials will add to the children's knowledge.

Winter clothing is a form of insulation that keeps body heat—a form of energy—from dissipating. Children may not have thought of clothing as insulation. Discussing the insulating properties of clothing applies to children's lives in a very practical way.

A Minnesota Energy Activity

Organizing Principle For Series D: The earth's energy sources are limited.

Unit 8 Concept: Insulating is a way to conserve energy.

How long can you make a ice cube last?

The Big Idea

Objective: To discover that some materials make better insulation than others.

Skills: Designing an experiment, predicting, observing, evaluating.

Materials: Uniformly-sized ice cubes, plastic sandwich bags, gallon milk cartons, and materials to be evaluated for insulating qualities. Possibilities are: cardboard, newspaper, rags, Styrofoam, sand.

Divide into teams. Each team is to have an ice cube in a plastic bag and a milk carton. The bag will hold the water as the ice melts. The goal is to insulate the milk carton so that the ice cube inside stays frozen as long as possible. Have each team choose and use only one type of insulating material.

How long can an ice cube be kept?

What seems to make the best insulation?

The poorest?

Other Learning Activities

How can a house made out of packed snow be comfortable to live in? Read about igloos to find out. Then draw a picture that illustrates how an igloo is made.

Could you make an igloo with the help of friends?

Interview an older person who grew up on a farm or in a rural community to find out what steps people took to keep their houses warmer and more draft-free in winter. Did they make use of such things as tarpaper? Straw or hay bales? Snow? Newspapers? Chicken feathers?

It's winter and some roofs have a lot of snow on them long after the snow has all melted off other roofs.

What might this tell you about insulation?

For the Teacher

Use the photograph and question on the front of this card to lead into the activity in which the children create insulated coolers. You can add challenge to the activity by setting up a contest that has a fixed goal—the preservation of an ice cube for three or more hours. To compare insulating qualities of various materials, each team should limit itself to one material.

We have suggested the use of same-size cartons simply as a ground rule. You may want to allow for more imagination and experimentation by having teams decide on what to use as containers as well as how to construct and insulate them.

Properly selected and installed insulation conserves significant amounts of energy. By giving children opportunities to experiment with the insulating materials, we heighten their awareness of energy and make them more receptive to the need to conserve it.

A Minnesota Energy Activity

Organizing Principle For Series D: The earth's energy sources are limited.

Unit 9 Concept: Recycling is a way to conserve energy.

 Who recycles and what do they recycle?

The Big Idea

Objective: To recognize that recycling is a matter of personal choice.

Skills: Gathering data, communicating, classifying.

Materials: Pencils and writing paper.

Making new products from used or recycled materials often saves energy. Work out a list of survey questions to find out how people in your community feel about recycling.

What are some reasons people choose not to recycle?

How can you find out who recycles?

How can you find out what they recycle?

Make a graph or chart showing the results of your survey.

Other Learning Activities

Locate a farmer or gardener who is cutting back on the use of manufactured fertilizer and is making more use of organic wastes. Invite this person to your classroom to talk about nature's way of enriching the soil.

Write a report or poem that describes how you have made something old that was going to be thrown away into something new that you could use.

Brainstorm to think of all the ways people in Minnesota make use of fall leaves.

Interview someone who remembers World War II and find out what people did about recycling at that time in history.

For the Teacher

Use the photograph and question on the front of this card to establish that through recycling we give value to things otherwise regarded as worthless. This reduces energy consumption.

Increasingly, people are recycling paper, bottles, and cans which they would otherwise discard as trash. It's a positive action in which teachers, students, and parents can participate. If your town doesn't have a collection center, your class might want to write to a city official to find out why not, and in the process learn a lot about local government and its priorities.

For many companies, recycling is common practice. Each year, more than 60% of discarded copper is recovered. Likewise, about 25% of all steel products and 50% of the aluminum products produced each year are eventually used again. Approximately 20% of all paper products are reclaimed.

Recycling saves our natural resources as well as the energy used to mine, log, or in some other way secure the raw materials needed for original manufacture.

On Card 10 of this series, directions are given for recycling paper. By turning old newspaper into a new paper product, children get an insight into the recycling process.

A Minnesota Energy Activity

Organizing Principle For Series D: The earth's energy sources are limited.

Unit 10 Concept: Recycling is a way to conserve energy.

What is valuable about trash?

The Big Idea

Objective: To participate in recycling.

Skills: Designing an experiment, measuring.

Materials: Newspaper, large mixing bowl, egg beater, rolling pin, pieces of metal screen about 10 by 12 cm (4 by 5"), wax paper, wallpaper paste, warm water, tablespoon.

Make your own recycled paper.

1. Fill a mixing bowl with two cups of warm water.
2. Tear up a double sheet of newspaper. Make *tiny* pieces and soak them in warm water for about an hour.
3. Use an egg beater to whip the paper until it is mushy. This mixture is called a "slurry."
4. Mix one heaping tablespoon of wallpaper paste in one cup of water. Stir this into the slurry with the egg beater.
5. Now you're ready to make a sheet of paper. Put the screen flat into the slurry. Dunk it up and down slowly until a thin layer of pulp (about 1/8th inch) covers the screen.
6. Place the pulp-covered screen on several layers of newspaper. Put wax paper over it. Gently roll the rolling pin over the wax paper several times. This will smooth the paper you're making and squeeze the water through the screen and into the newspaper.
7. Remove wax paper.
8. Pick up the screen by the edges and put it on dry newspaper.
9. Allow to dry about 24 hours before peeling off the paper.

What gives the paper color?

What do you see when you hold the paper up to the light?

How would the paper be different if you made it from tissue paper instead of newspaper?

Other Learning Activities

Plan and carry through a recycling project, being sure you have a taker for what you collect.

How can you publicize the project?

Put together a display of things made from recycled paper.

Create sculpture from junk by applying imagination to thrown away things.

For the Teacher

Use the photograph and question on the front of this card to begin your discussion of the value of trash. (Has anyone visited a dump or sanitary landfill? What was it like? Did there seem to be anything useful there?)

Although we have the technology to recycle much of our trash, tons of useful materials are still being buried because the cost of recovery is too high. But as land becomes more valuable and burial sites harder to find, recycling will increase.

The paper-making project suggested on this card results in a gray-blue paper. The color comes from the ink. Although the project is a little messy, the final result is well worth the effort. To make a larger sheet of paper, pour the slurry into a rectangular cake pan and cut a piece of screen slightly smaller than the pan so you can still handle it by the edges. Slide the screen into the slurry so that the wood pulp forms a layer as you lift the screen up to drain off the water. The resulting paper looks somewhat like rice paper and can be used for art projects. Try it.

Minnesota Energy Activities

For Elementary Students

Minnesota Department Of Education
Minnesota Energy Agency

LEVEL A for Ages 4-6

WHAT IS ENERGY? WHAT DOES ENERGY DO? WHERE DOES ENERGY COME FROM?

1. Energy is the "go" of things.
2. Our bodies need energy. Energy comes from the food we eat.
3. Energy moves things. The energy to move things comes from many sources.
4. Energy lights things. There are many sources of light.
5. Energy heats things. There are many sources of heat.

LEVEL B for Ages 5-7

WE FIND ENERGY IN MANY PLACES

1. We get energy from the sun.
2. We get energy from the wind.
3. We get energy from water.
4. We get energy from wood, coal, oil, and gas.
5. We use the energy of electricity.

LEVEL C for Ages 6-8

ENERGY DOES ALL THE WORK IN THE WORLD

1-2. Work happens when something moves or changes.
3-4. Energy has to be put into a machine before we can get work out of it.
5-6. People invent machines to do work.
7-8. There are more machines now than in the past.
9. Some of the machines we use today are more important to us than others.
10. In some countries people use fewer machines and less energy than we do.

LEVEL D for Ages 7-9

THE EARTH'S ENERGY SOURCES ARE LIMITED

1-2. Major energy sources in use today are unevenly distributed around the world and must be transported to where they are needed.
3-4. Energy sources are either renewable or nonrenewable.
5-6. Cutting consumption is a way to conserve energy.
7-8. Insulating is a way to conserve energy.
9-10. Recycling is a way to conserve energy.

LEVEL E for Ages 8-10

ENERGY CHANGES FROM ONE FORM TO ANOTHER

1-2. Energy is either waiting (potential energy) or it is working (kinetic energy).
3-4. We use some forms of energy without changing them.
5-6. Energy can be changed (converted) from one form to another to make it more useful.
7-8. There are natural and technological conversion systems.
9-10. Energy is wasted in conversion.

LEVEL F for Ages 9-11

THE ENERGY SITUATION AFFECTS MINNESOTANS TODAY

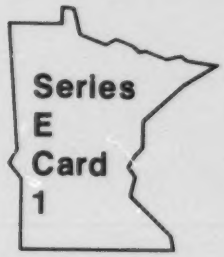
1-2. Minnesota has special energy problems.
3-4. The cost of energy has an economic impact on families.
5-6. Jobs are dependent on energy availability.
7-8. Energy use has environmental consequences.
9-10. Conservation is everybody's business.

LEVEL G for Ages 10-13

THE ENERGY SITUATION WILL AFFECT THE FUTURE

1-2. Because Minnesota's energy resources are limited, we need to look at alternative sources.
3-4. Alternative energy sources continue to be developed.
5-6. By making use of wastes, we conserve energy.
7-8. The energy situation has an international impact.
9-10. Further advances in energy-related technology will have an impact on our lives that is difficult to imagine.

A Minnesota Energy Activity



Organizing Principle For Series E: Energy changes from one form to another.

Unit 1 Concept: Energy is either waiting (potential energy) or it is working (kinetic energy).

When does a pendulum have energy?

The Big Idea

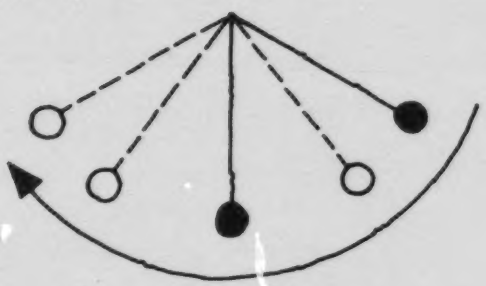
Objective: To make a simple apparatus that illustrates potential and kinetic energy.

Skills: Designing an experiment, observing, inferring.

Materials: Strong thread or string, weights for pendulum bobs: nuts, bolts, sinkers, stones.

Use a piece of string and a weight to make a pendulum. The weight is called the "bob." When you hold the bob to one side like this

it is at rest and is waiting to do work. It has "potential energy." When you release the bob, it swings into motion and has "kinetic energy."



The pendulum demonstrates how potential energy changes to kinetic energy and how kinetic energy changes back to potential energy. The changing of energy from one state to another is called the transformation of energy.

What gives the pendulum its "go"?

What happens to a pendulum when you shorten or lengthen the string?

Develop an experiment to find out if the weight of the bob makes any difference in how long or how fast the pendulum swings.

Other Learning Activities

Observe a pendulum clock or a pendulum game.

What is its source of energy?

How could you make a timing device with a pendulum?

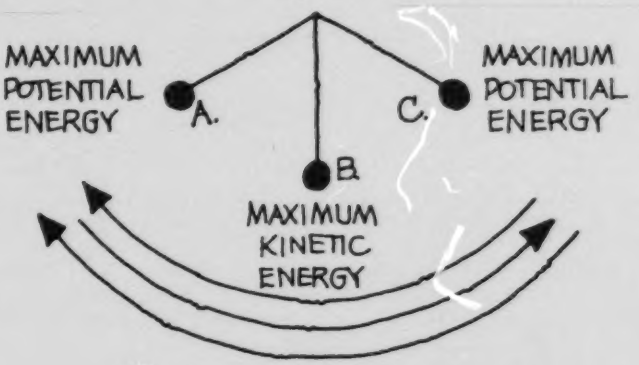
For the Teacher

The photograph and question on the front of this card are meant to stimulate thought about energy and interest students in carrying through the learning activities.

Before working with pendulums, discuss kinetic and potential energy.

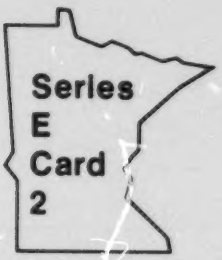
Potential energy (the energy of position) is illustrated by such things as a rock atop of cliff, water behind a dam, a bullet in a gun, a spring-set trap, a pile of wood. The transformation to kinetic energy (the energy of motion) takes place when the rock topples, the water releases, the gun fires, the trap snaps, and the wood burns.

The pendulum is one of the best means of illustrating the two energy states because of the constant change from one state to the other. When the bob is released at A it swings downhill until it reaches its maximum kinetic energy at B. It continues swinging upward until at C it must come to rest where it will have its maximum potential.



The pendulum exerts the greatest force at the bottom—or middle—level when it's moving. This can be observed when a building is being wrecked by a wrecking ball. The ball has the greatest impact when it is straight down. On its upward swing, the ball begins using its energy to resist the force of gravity.

A Minnesota Energy Activity



Organizing Principle For Series E: Energy changes from one form to another.

Unit 2 Concept: Energy is either waiting (potential energy) or it is working (kinetic energy).

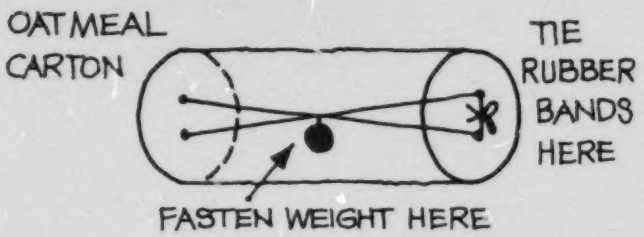
What does energy input have to do with kicking a ball?

The Big Idea

Objective: To recognize that the energy input determines the energy output.

Skills: Designing an experiment, observing, measuring.

Materials: Empty oatmeal containers and covers, a variety of rubber bands, scissors, weights such as large fishing sinkers, meter stick.



To create your roller-toy, work in small groups. Use the illustration for the basic design. The roller-toy is wound by rolling it slowly on a smooth surface. When you let the toy go, it should roll back. You may have to do some experimenting to get the toy to work properly.

Should the rubber bands be thick or thin? Loose or taut?

How large a weight is needed?

Does it matter whether the rubber bands run = or X ?

Cutting a window in your model to observe what happens may help you improve the design.

When you have designed the best model you can, measure how far you push it to wind it up.

How far will it roll back?

What does this tell you about energy input and output?

Other Learning Activities

Invite an archer to your classroom to demonstrate a bow and arrow.

What can be learned about input and output from archery?

Do some research on catapults. Then design one. How about setting up a catapult contest?

For the Teacher

The photograph and question on the front of this card are meant to stimulate thought about the energy that gives things their "go" and interest students in carrying through the learning activities. In doing the activities, have the children work in groups whenever possible. This gives them an opportunity to develop interpersonal skills and gives you a chance to step back and observe how they work with and relate to one another.

You may want to review the idea that energy is the "go of things." Try to elicit ideas from the children which make the point that everything we do from kicking a ball to bike riding to paddling canoes requires energy. The energy put into these activities determines the energy output.

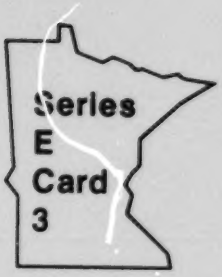
Much of the value of working with the roller-toy comes from the investigation and experimentation. Children will discover that the further the toy is pushed to wind it up, the greater the distance it will return. There is a point, however, at which the device is completely wound. Children may also discover that no matter how wound up the toy is, it will not return to the starting point. (No machine is 100% efficient.)

The idea that the more energy we put into something, the more work we get out of it, can be demonstrated outdoors with a ball throw. The harder one throws (input), the farther the ball goes (output).

A Minnesota Energy Activity

Organizing Principle For Series E: Energy changes from one form to another.

Unit 3 Concept: We use some forms of energy without changing them.



How can these skaters demonstrate that wind is a form of energy?

The Big Idea

Objective: To investigate ways to use wind energy directly.

Skills: Designing an experiment, observing, divergent thinking.

Materials (This is a windy day activity.): Paper plates, stapler, scissors, string.

Could *you* put the wind to work? To find out, take the materials outside on a windy day. Try to create something that the wind will hold in the air. (It may take some experimenting, so be prepared to change designs!)

Should your creation be shaped like a kite? A plane? A bird? A wing?

How many seconds will your creation stay in the air?

Can you determine wind direction with your creation?

How can knowing the wind direction be helpful to anyone wanting to use the wind as a source of energy?

Other Learning Activities

Invite someone who sails to come to your classroom and share information about sailing.

How is it possible to sail into the wind?

Write a poem about the wind. Remember that poems can rhyme, but they don't have to.

Gather information on hang gliders to find out how they use the wind as a direct source of energy. Summarize what you discover in a short report.

For the Teacher

The photograph and question on the front of this card are meant to stimulate thought about the direct use of wind energy and interest students in carrying through the learning activities. If the girls in the photo were to skate with the wind at their backs, they would be making direct use of wind as a source of energy. They might also hold up their jackets to form sails.

The direct use of wind as an energy source has been recognized for centuries. Builders of sailing ships and windmills found practical ways to take advantage of this "free" resource. Unfortunately, wind is neither a dependable nor a versatile source. Efficient and pollution-free as wind may be, it is hard to adapt its use to today's needs because it can't be stored or transported. Although many studies are being done with wind-powered generators, the wind remains a constant but secondary source of energy.

Wind experiments help children understand the dynamics of wind. Such experimentation should be encouraged in the hope that through it more uses for this renewable resource will be found. Sail cars, sailboats, wind chimes, box kites, windmills, mobiles, and stabiles are some of the things the students can create in an attempt to demonstrate the direct use of wind energy. Based on the definition of energy as the "go of things," whatever students design must "go with the wind." An electric fan may be used as a wind source in the classroom, but outdoor tests should also be done.

To understand how wind chill is figured, see the WIND CHILL FACTOR "Information Card" that accompanies this series.

INFORMATION CARD

We find out how cold it is in the winter by looking at the thermometer. But the thermometer reading alone doesn't tell us how cold it feels. A lot of our feeling of cold comes from the wind. The faster the wind blows, the faster our bodies lose heat. As the speed of the wind increases, so does our feeling of cold. Wind chill is an estimate of how cold the wind makes us feel. For instance, when the temperature is 10° F and the wind is blowing at a speed of 15 mph, the wind child temperature is equal to -20° F. This means that with a 15 mph wind at 10° F we feel as cold as we do when the temperature is -20° F and the wind is calm.

The wind chill measurements were developed in 1963 from experiments done in Antarctica. Wind, however, is not the only factor that makes us feel cold. A thin person or someone whose clothes are wet will lose more heat and feel colder than another person. Being aware of the wind chill reading on a given day helps us know how to dress for the weather.

WIND CHILL FACTOR

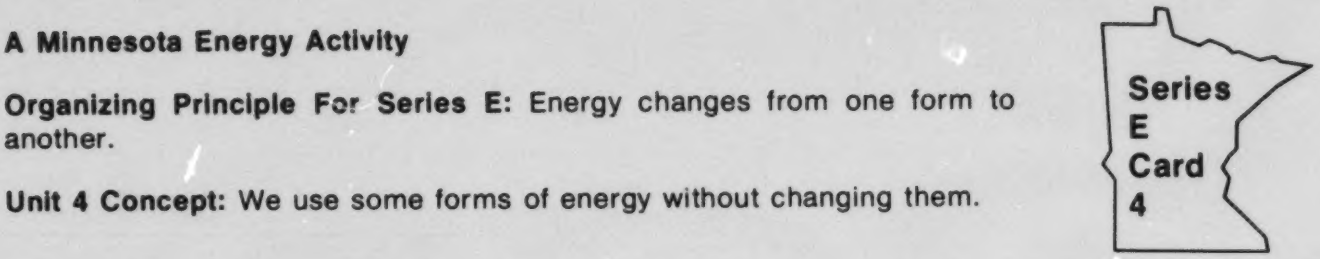
WIND SPEED	COOLING POWER OF WIND EXPRESSED AS "EQUIVALENT CHILL TEMPERATURE"																			
MPH	TEMPERATURE (°F)																			
CALM	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45	-50	-55	-60
	EQUIVALENT CHILL TEMPERATURE																			
5	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45	-50	-55	-65	-70
10	30	20	15	10	5	0	-10	-15	-20	-25	-35	-40	-45	-50	-60	-65	-70	-75	-80	-90	-95
15	25	15	10	-0	-5	-10	-20	-25	-30	-40	-45	-50	-60	-65	-70	-80	-85	-90	-100	-105	-110
20	20	10	5	0	-10	-15	-25	-30	-35	-45	-50	-60	-65	-75	-80	-85	-95	-100	-110	-115	-120
25	15	10	0	-5	-15	-20	-30	-35	-45	-50	-60	-65	-75	-80	-90	-95	-105	-110	-120	-125	-135
30	10	5	0	-10	-20	-25	-30	-40	-50	-55	-65	-70	-80	-85	-90	-95	-100	-110	-115	-125	-130	-140
35	10	5	-5	-10	-20	-30	-35	-40	-50	-60	-65	-75	-80	-90	-100	-105	-115	-120	-130	-135	-145
40	10	0	-5	-15	-20	-30	-35	-45	-55	-60	-70	-75	-85	-95	-100	-110	-115	-125	-130	-140	-150
WINDS ABOVE 40 HAVE LITTLE ADDITIONAL EFFECT.	LITTLE DANGER					INCREASING DANGER (Flesh may freeze within 1 minute)						GREAT DANGER (Flesh may freeze within 30 seconds)									
	DANGER OF FREEZING EXPOSED FLESH FOR PROPERLY CLOTHED PERSONS																			

A MINNESOTA ENERGY ACTIVITY
(Information card to accompany
Card 3 of Series E)

A Minnesota Energy Activity

Organizing Principle For Series E: Energy changes from one form to another.

Unit 4 Concept: We use some forms of energy without changing them.



How can you use the sun's energy?

The Big Idea

Objective: To demonstrate the direct use of the sun's energy.

Skills: Designing an experiment, measuring, divergent thinking.

Materials: (This is a spring activity.) A 5-quart plastic ice cream pail *or* a cardboard box and a plastic garbage bag to surround it *or* enough boards to make a 4-sided frame (for this you'll need a saw, hammer, and nails); in addition you'll need clear plastic sheeting and 2 thermometers.

A cold frame is like a low greenhouse. Gardeners use them to get plants growing early in the spring.

1. A simple cold frame can be made from an ice cream pail. Tape clear plastic over the top. Place the pail in a sunny, sheltered spot outside and put dirt around the bottom so no air flows under the pail.

2. Another cold frame can be made from a cardboard box set in a garbage bag (to make it easy to dispose of later). Cover with clear plastic and place outside as suggested in #1 above.

3. The typical cold frame is made from wood. Before building, decide on a size. Then cut the boards and nail together to form a 4-sided box about one meter (3') square. Cover with clear plastic and place outside as suggested in #1 above.

Check the temperature inside and outside your cold frame. Do this several times each day for a week.

How do you explain the results?

Will a cold frame affect the temperature of the earth 2-5 cm below ground? Devise a way to find out.

How would you insulate a cold frame?

Would the color of the plastic used to wrap a cardboard box cold frame affect the temperature?

Other Learning Activities

Plant seeds in containers in the classroom. When seeds sprout, keep some containers in the room. Place others outdoors both in and out of a cold frame.

Which plants grew the best?

Which grew the least well? Why?

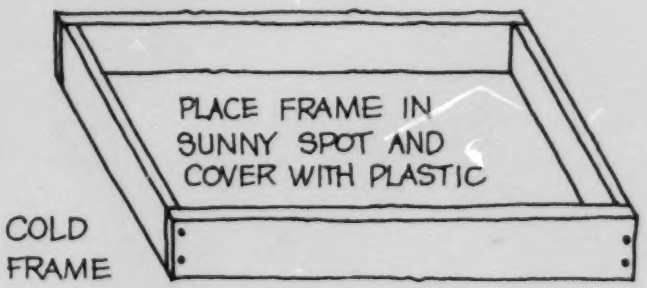
Visit a greenhouse on a sunny day. How does a greenhouse make a direct use of the sun's energy?

For the Teacher

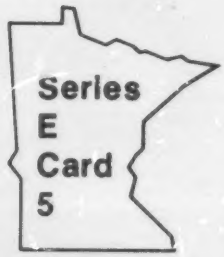
The photograph and question on the front of this card are meant to stimulate thought about use of the sun's energy and interest students in carrying through the learning activities.

Early spring—when the snow is gone but frost is still a possibility—is the best time for building a cold frame or small greenhouse. A cold frame is, in effect, a solar panel. Somewhere near the top of the frame you might want to make a small hole that can be taped or plugged. When the tape or plug is removed, the children can feel warm air.

Some other direct uses of the sun's energy that you may want to mention include the preservation of food by sun-drying meat, fish, and fruit; the evaporation of water to obtain salt from brine; solar cooking. (The solar cell, which changes—converts—sunlight into electricity, involves conversion and is thus an indirect use of the sun's energy. Conversion is introduced on Cards 5 and 6 of this series.)

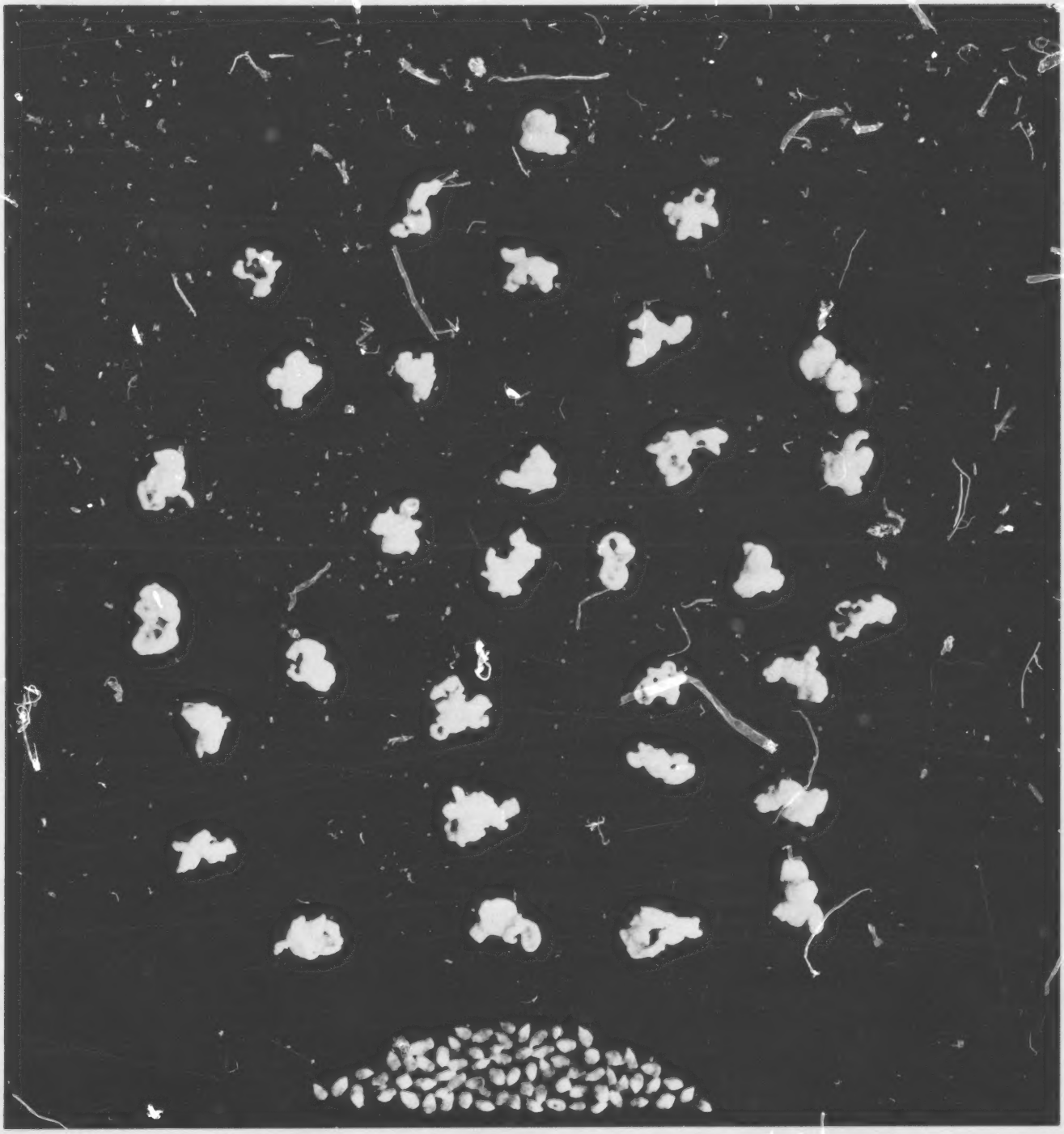


A Minnesota Energy Activity



Organizing Principle For Series E: Energy changes from one form to another.

Unit 5 Concept: Energy can be changed (converted) from one form to another to make it more useful.



What makes popcorn pop?

The Big Idea

Objective: To investigate the usefulness of steam as a source of energy.

Skills: Observing, communicating.

Material: Magnifying glass, popcorn popper, popcorn, cooking oil, hot plate. A ready-to-pop container of popcorn—available in most supermarkets—simplifies the activity).

When one form of energy changes to another form, it is called conversion. Pop some popcorn and you will witness conversion taking place. Fresh kernels of popcorn have moisture inside them. When these kernels are heated, the moisture turns to steam. The hard covering keeps the steam from escaping until the pressure becomes so great that the kernel pops (converts) into food we can eat. There will probably be a few unpopped kernels in the bottom of the popper. Compare a popped kernel with a heated but unpopped kernel and an unheated kernel. Use a magnifying glass to examine the popcorn carefully. Record your observation.

How are the three kernels alike?

How are they different?

Other Learning Activities

Boil water in a glass pan or coffee maker. Add food coloring and observe what happens.

What makes the water boil?

What is the source of the heat energy?

Is all the heat going into making the water boil?

Where else is it going?

Is the color of the steam the same as the color of the water?

If there is a change in the color, can you explain why?

What happens if you hold a pinwheel over the steam?

How many energy changes (conversions) are occurring?

How could you find out what James Watt had to do with the steam engine?

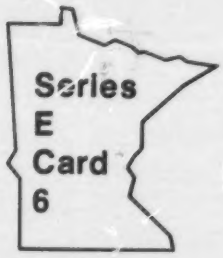
For the Teacher

The photograph and question on the front of this card are meant to stimulate thought about steam as a source of energy and interest students in carrying through the learning activities.

Popping corn is an interest-getting activity that provides a visual demonstration of conversion. One shortcoming of the activity is that the changing of moisture to steam within the kernels cannot be observed. The activity is used primarily to introduce the word "conversion" and should be followed up by the activity involving the boiling of water. Here the students see heat converting water to steam. They also see that not all the heat energy is being converted to steam. This leads them to the understanding that conversion involves heat, motion, light, and sound. Be aware that whenever liquids are boiled in the classroom, Minnesota law requires that protective eye covering be worn.

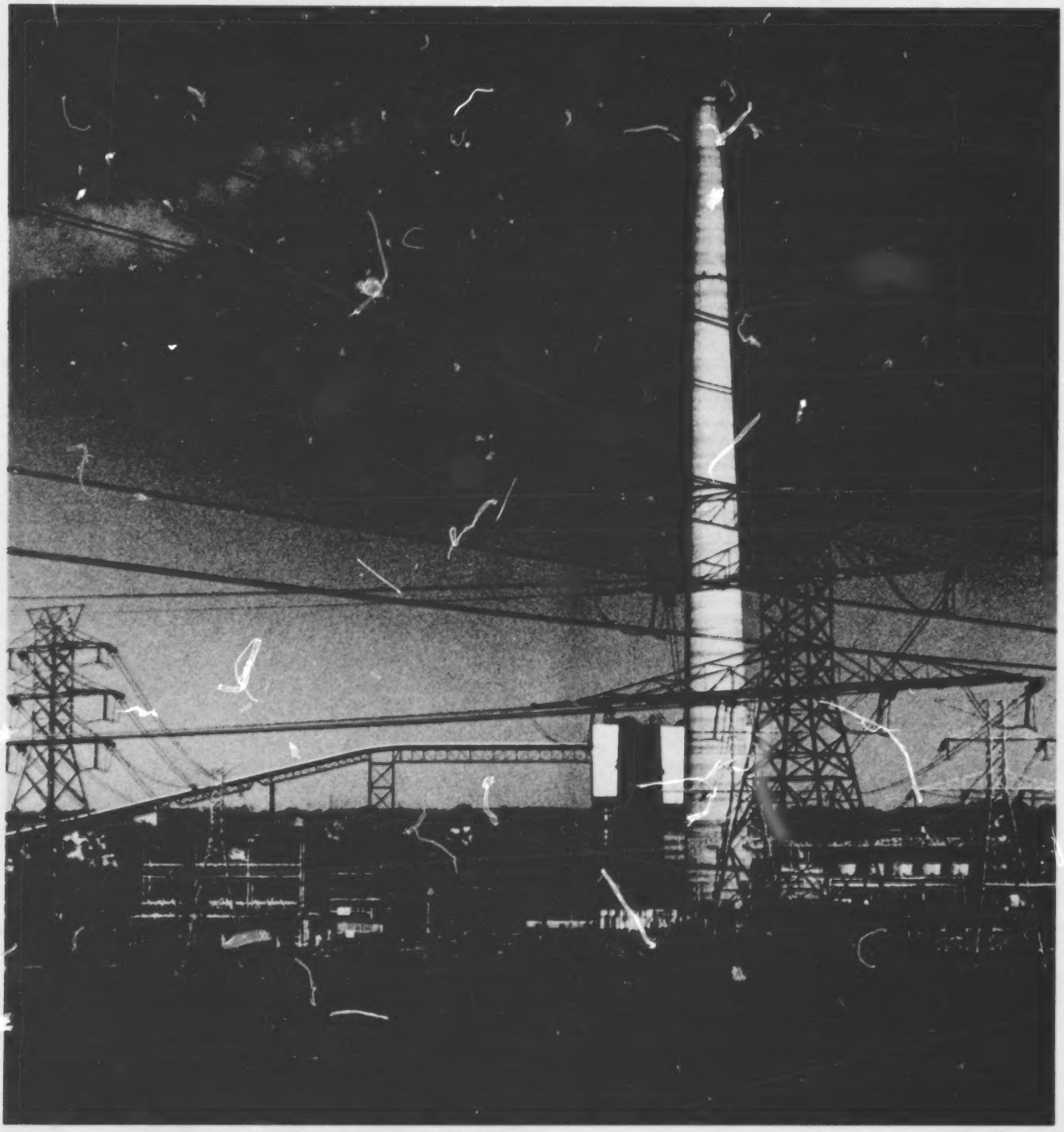
While considering the uses of steam, you may want to introduce geothermal energy. The earth contains natural steam underground which, in some parts of the world, can be tapped. Iceland and New Zealand are two countries that make extensive use of this clean and inexpensive energy source.

A Minnesota Energy Activity



Organizing Principle For Series E: Energy changes from one form to another.

Unit 6 Concept: Energy can be changed (converted) from one form to another to make it more useful.



How do we use the energy of coal?

The Big Idea

Objective: To be aware of the usefulness of energy-to-energy conversions.

Skills: Communicating, analyzing, classifying.

Materials: Pencils and paper.

Coal has potential energy, but how will we make use of that energy? To make this fossil fuel more useful we convert it into another form of energy. Here is an energy chain that shows how hard-to-use coal can be converted into easy-to-use electricity.

As coal is burned in a power plant, it is converted to heat.

▼

The heat is used to change water into steam.

▼

The steam is used to turn a generator that produces electricity.

▼

The electricity is now used in many ways.

▼

1. *As heat energy.*
   Heating pad.
2. *As light energy.*
   Light bulb.
3. *As energy of movement.*
   Train.
4. *As sound energy.*
   Radio.
5. *As chemical energy.*
   Charging a battery.
6. *As magnetic energy.*
   Electromagnet.

Use pictures and diagrams to show other energy chains. Do an energy chain that begins with one of the following:

Water stored behind a dam;

wood; petroleum; wind.

Other Learning Activities

Arrange a field trip to a power plant. Look for examples of energy conversion while you are there.

Make a drawing of an automobile. Label the drawing to indicate energy conversions.

What change takes place when you turn on the radio?

Where is energy converted into heat? Light? Movement? Sound?

For the Teacher

The photograph and question on the front of this card are meant to stimulate thought about ways energy is converted to make it more useful and interest students in carrying through the learning activities.

In energy-to-energy conversions, only the forms or states of energy are changed. No additional energy is created. In any conversion, we get less out than we put in. When coal is converted to electricity, a lot of unused heat and light escape. The conversion process in this instance is less than 50% efficient. That is, more than half the energy is wasted. Where does the energy go? An example of energy loss is the light bulb. It doesn't give off just light, it also gives off heat energy that may be wasted. An electric space heater, on the other hand, doesn't give off just heat. It also gives off wasted light. (On Card 9 the loss of energy in conversion in explored in more detail.)

Whatever the form of energy, the sun is the original source. In developing energy chains, the students should be able to trace back to the sun. The food chain is a good place to begin:

Sun-Plants-Animals-Our Food Supply

Help students see that all along the way there is an energy loss and that some losses are greater than others. Eating beef, for instance, is more energy wasteful than eating grains.

A Minnesota Energy Activity

Organizing Principle For Series E: Energy changes from one form to another.

Unit 7 Concept: There are natural and technological conversion systems.

Where does a plant get the energy to grow?

The Big Idea

Objective: To discover that a green plant is a natural energy conversion system.

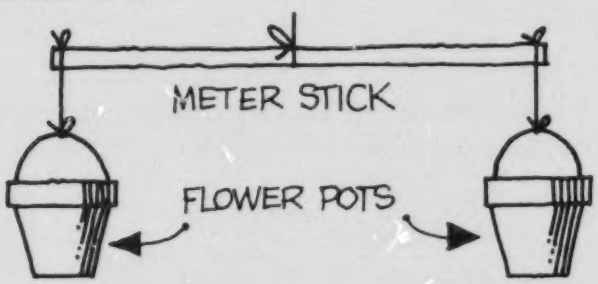
Skills: Designing an experiment, measuring, observing.

Materials: Potting soil, planting container, bean seed, balance scale.

Try an experiment with a plant and sunlight.

1. Dry the soil that is to be put in the planting container in an oven or in bright sunlight.

2. When all the moisture is out of the soil, weigh it and record. If you do not have a balance scale for weighing, make your own scale.



3. Plant the seed, water it, and place the container in the sun. Let the plant grow for two weeks or longer, adding water when needed.

4. At the end of the time period, pull the plant. Be *very careful* to keep all the roots. Separate the plant and the soil. It's *important* to save every bit of soil.

5. Dry the soil and the plant in an oven or under bright lights. Dry until the weight is constant.

6. Weigh the plant and weigh the soil.

Did the plant gain or lose weight as compared with the seed?

Did the soil gain or lose weight?

Did the soil lose as much weight as the plant gained?

Where did the plant get the extra material?

Could we get energy back from the plant?

Could we get that energy to work? How?

Other Learning Activities

Diagram and illustrate an energy chain to show how the sun is the source of our body energy.

Use a calorie chart to figure out how many calories you eat in a day. Compare your diet with that of a person in a Third World country.

For the Teacher

The photograph and question on the front of this card are meant to stimulate thought about energy conversion and interest students in carrying through the learning activities.

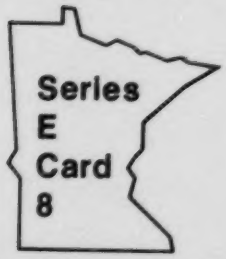
A green plant is a natural conversion system. The plant takes the sun's energy and manufactures food with it. Through photosynthesis, the sun supplies the energy that allows the plant to change water and carbon dioxide into sugar. Food is sometimes called "stored sunlight" because plants capture sunlight and store it as sugar.

In this experiment with the plant the children will discover that the soil did not lose as much weight as the plant gained. The plant got the energy it needed to grow from the sun, not the soil. If we wanted to get energy back from an edible plant, a human or animal could eat it, thus converting the plant's energy into body energy. Or we might burn the dried plant and use the heat to boil a few drops of water.

A Minnesota Energy Activity

Organizing Principle For Series E: Energy changes from one form to another.

Unit 8 Concept: There are natural and technological conversion systems.



How many ways can you think of to use the energy of a battery?

The Big Idea

Objective: To be aware of various methods people have devised to convert energy from one form to another.

Skills: Designing an experiment, measuring.

Materials: 6 same-size glass containers (bottles, jars, cans, or glasses), metric ruler, pencil, water.

Line up six glass containers of the same size and fill them with varying amounts of water.

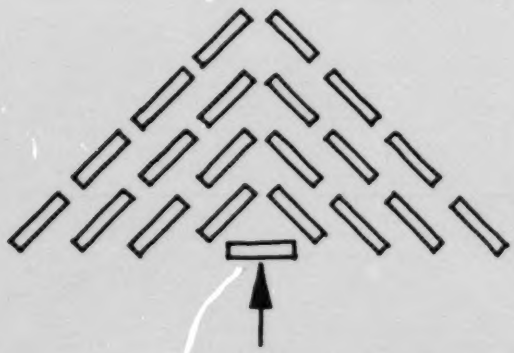
One: 1.2 cm (½") of water.
Two: 2.5 cm (1") of water.
Three: 3.8 cm (1 ½") of water.
Four: 5.0 cm (2") of water.
Five: 6.2 cm (2 ½") of water.
Six: 7.6 cm (3") of water.

Use a pencil to tap the glass containers near the top.

What form of energy is being converted to what form of energy?

Could you hang bottles from strings, fill them with varying amounts of water, and make your own orchestra?

Other Learning Activities



Set up dominoes in this pattern. What happens when you push at the arrow? Do some research on "chain reactions."

What pattern could you create to demonstrate a chain reaction?

Make an electro magnet. (See SERIES C, CARD 4 for directions.)

What energy conversions take place?

For the Teacher

The photograph and question on the front of this card are meant to stimulate thought about energy conversion and interest students in carrying through the learning activities.

While working with conversion activities, students should be able to identify changes taking place. In the picture on the front of this card the mechanical energy of the person (pushing the game bottons) activates the chemical energy of the battery which becomes electrical energy that is converted into sound and light as the game is played.

The tapping of water-filled glasses illustrates a change *from* mechanical energy *to* sound energy. (Observing the plucking of any stringed instrument allows children to "see" the mechanical-to-sound conversion taking place.)

A battery illustrates a change *from* chemical *to* electrical energy. That electrical energy is changed *to* magnetic energy in the electromagnet.

Consider the solar cell. Instead of the more common conversion of electricity to light, the conversion is *from* light *to* electricity.

Here are other conversions to discuss in clarifying the "from-to" process:

From heat to motion—hot air balloon, thermometer.

From motion to heat—drilling, hammering, rubbing.

From motion to electricity—bike or car generator.

From chemical to light—firefly.

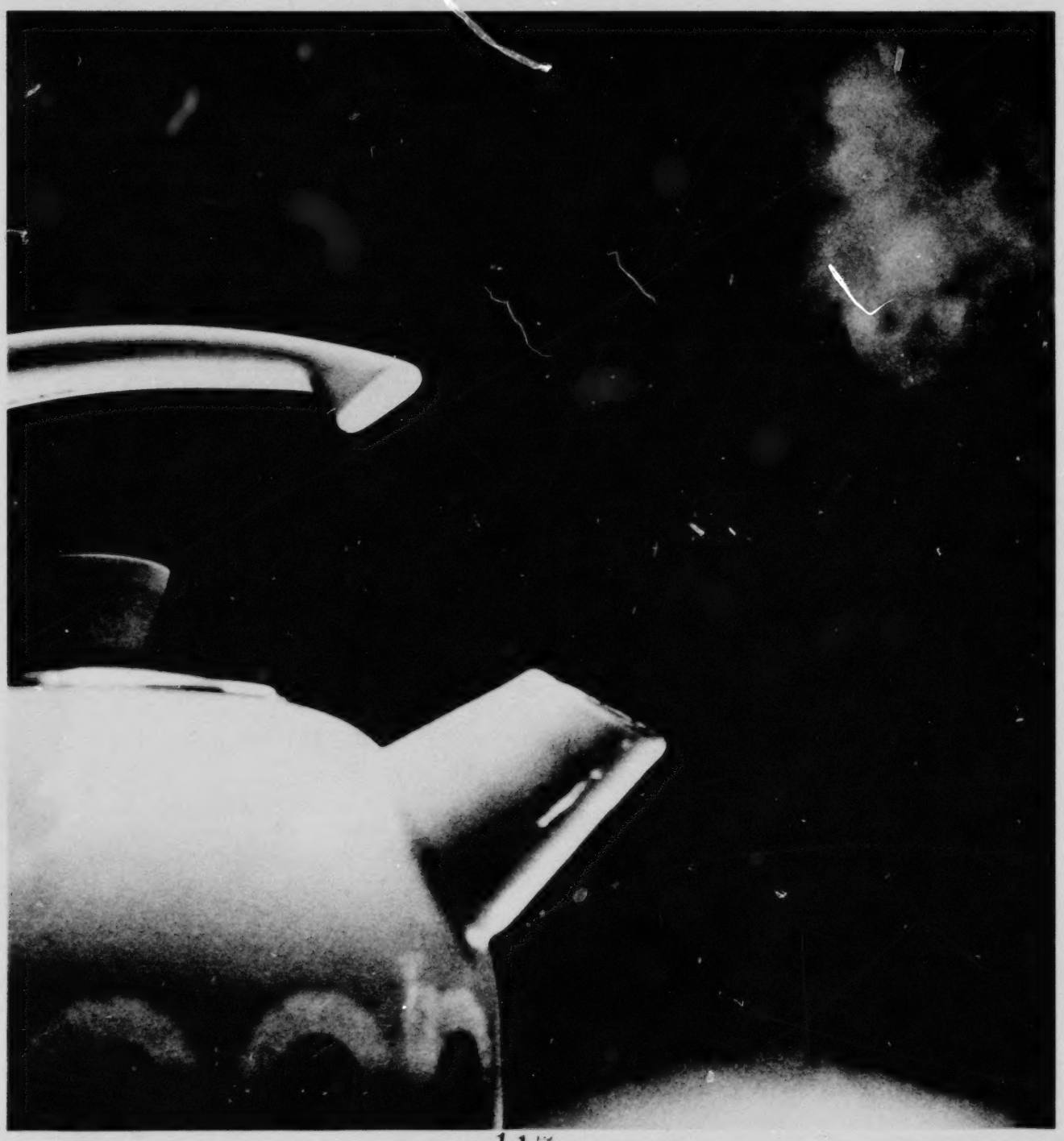
From light to chemical—photographic paper.

A Minnesota Energy Activity

Organizing Principle For Series E: Energy changes from one form to another.

Unit 9 Concept: Energy is wasted in conversion.

Series E Card 9



Is any energy wasted when water is being heated?

The Big Idea

Objective: To discover that in every conversion there is a loss of usable energy.

Skills: Designing an experiment, observing, analyzing.

Materials: Beaker of water, source of heat (alcohol lamp, hot plate, butane torch), thermometer.

Try this experiment to make some discoveries about conversions.

1. Put water in a beaker and let it stand until it is at room temperature.

2. Heat to 35° C (95° F). For the purpose of this experiment, it is not necessary that the water boil. (Minnesota law requires that protective eye covering be worn whenever liquids are boiled in the classroom.) Record the temperature every minute while heating. Remove the beaker from the heat source as soon as the water reaches 35° C.

3. Make a prediction. Will it take more time or less time for the water to cool back to room temperature than it took to heat it to 35° C?

4. Let the water cool. Record the temperature every minute until it reaches the beginning temperature.

5. Did all the heat from the heat source go into the water? How do you know?

Other Learning Activities

At home, observe as many electrical appliances as you can while they are running.

> Is there any heat energy being lost by a toaster? A TV set? A drill? A fan? How can you tell?

Set up an experiment to find out which gives off the most light and the most heat—a 40-watt fluorescent tube or a 40-watt incandescent bulb.

> How would the results of your experiment be of help to someone who was building or remodeling a home and wanted to conserve electricity?

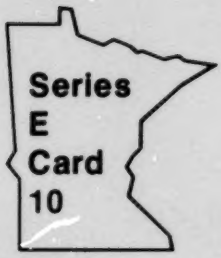
For the Teacher

The photograph and question on the front of this card are meant to stimulate thought about energy loss in conversion and interest students in carrying through the learning activities.

Energy can neither be created nor destroyed, but in every conversion some energy is lost in the sense that it cannot be reclaimed for future use. Heat loss is the most commonly recognized form of waste. Hold your hand close to your cheek and you'll detect heat flowing away from your body much the way heat flows away from an automobile engine and is lost. A less commonly considered energy waste in conversion is noise. The "tick" of a watch, the "roar" of an engine, and the "crack" of a rifle are examples of wasted energy resulting from a conversion.

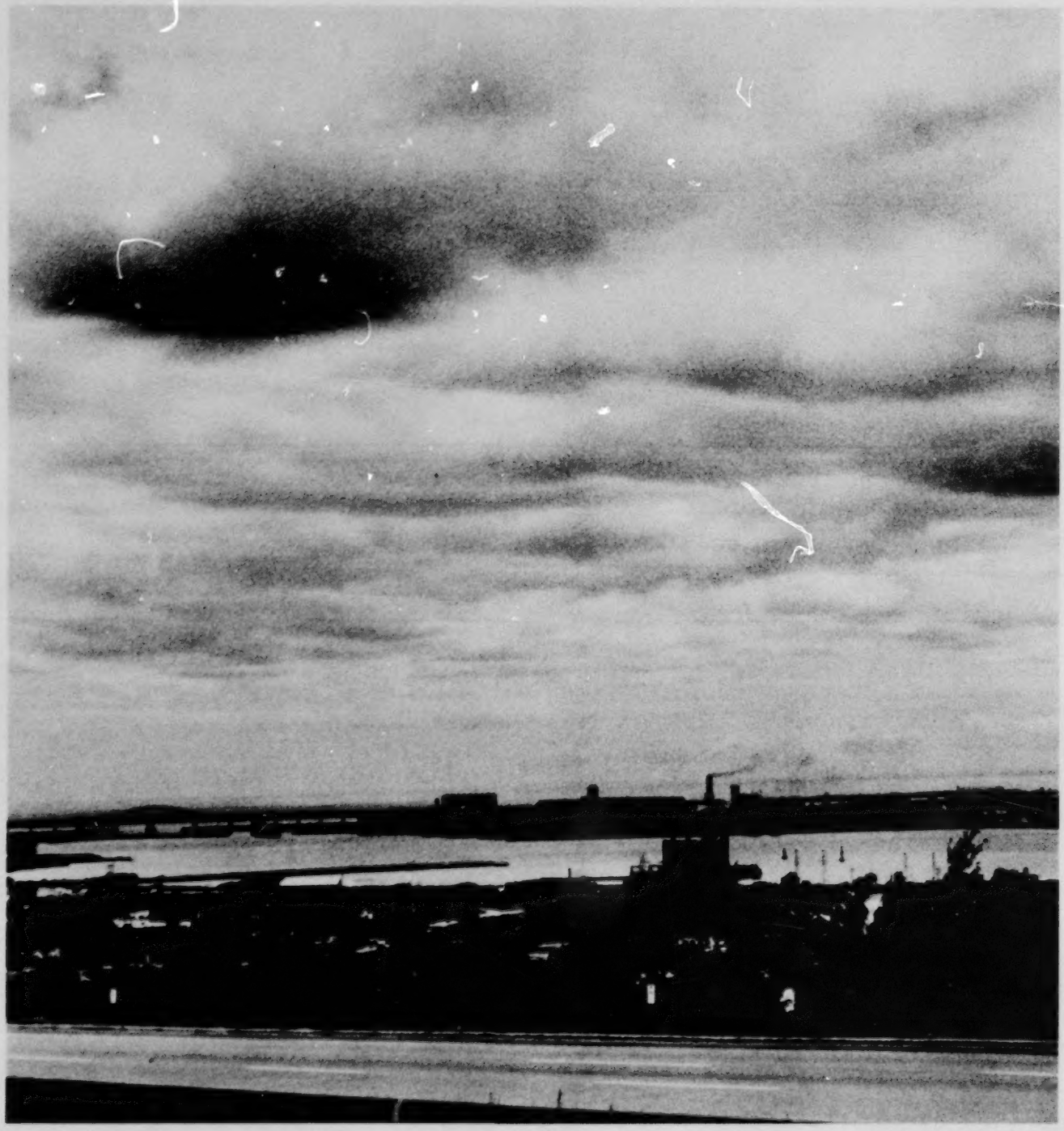
In heating the beaker of water, the children should be able to recognize that some of the heat energy given off by the heat source is wasted because it is not flowing in a "useful direction" to heat the water. Likewise, light energy from the heat source is also being lost. During the heating season, heat "lost" from lights is useful as heat in offices and homes. In summer, however, heat loss from appliances and light fixtures may require additional energy for air conditioning to create a comfortable environment.

A Minnesota Energy Activity



Organizing Principle For Series E: Energy changes from one form to another.

Unit 10 Concept: Energy is wasted in conversion.



How can you find out if there are pollutants in the air?

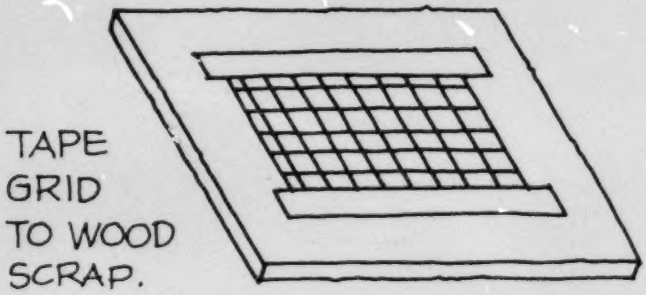
The Big Idea

Objective: To recognize that energy conversion creates pollution.

Skills: Designing an experiment, observing, evaluating.

Materials: Waxed paper, petroleum jelly, metric ruler, pencil, tape, lumber scraps, magnifying glass. (If you have access to a microscope, do the activity with microscope slides and petroleum jelly.)

To make pollutant catchers, put together two pollutant traps. Cut two pieces of waxed paper about 10-15 cm (4-6") square and mark a 1 cm (½") grid on each one with a pencil. Then tape this grid to a small scrap of wood.



Smear a thin coating of petroleum jelly over the paper grids. Then find two places—one inside and one outside—where you can set the traps for at least a week without anyone disturbing them.

In a week, compare the number of particles from the two locations. (The grid is helpful in obtaining an average for each trap.) Identify as many particles as possible. Make a chart which describes your findings.

Other Learning Activities

Tie a facial tissue or handkerchief over the exhaust pipe of one or more cars. Then have the driver of the car run the engine for a minute or less. (Note: Be very careful. Exhaust contains carbon monoxide, a poison you cannot smell.)

How do exhausts of different cars compare?

Examine scrapings from the wall of a fireplace or the lid of a wood-burning stove.

What is the material?

Is it water soluble?

Where did it come from?

What does it tell you about energy conversion?

For the Teacher

The photograph and question on the front of this card are meant to stimulate thought about pollution as it relates to energy conversion and interest students in carrying through the learning activities.

The pollutant catchers coated with petroleum jelly will pick up various airborne particles. In comparing what is caught indoors and outdoors, students should be able to distinguish some differences and speculate about the reasons for those differences. The experiment reveals only that particles from many different sources float in the air. More sophisticated tests would be necessary to determine the pollutant given off by a specific energy conversion.

Traps can be set near chimneys or smokestacks (taking into consideration prevailing winds). Visual checks can be made of the air, and in winter the snow can be examined for pollutants.

Minnesota Energy Activities

For Elementary Students

Minnesota Department Of Education
Minnesota Energy Agency

LEVEL A for Ages 4-6

WHAT IS ENERGY? WHAT DOES ENERGY DO? WHERE DOES ENERGY COME FROM?

1. Energy is the "go" of things.
2. Our bodies need energy. Energy comes from the food we eat.
3. Energy moves things. The energy to move things comes from many sources.
4. Energy lights things. There are many sources of light.
5. Energy heats things. There are many sources of heat.

LEVEL B for Ages 5-7

WE FIND ENERGY IN MANY PLACES

1. We get energy from the sun.
2. We get energy from the wind.
3. We get energy from water.
4. We get energy from wood, coal, oil, and gas.
5. We use the energy of electricity.

LEVEL C for Ages 6-8

ENERGY DOES ALL THE WORK IN THE WORLD

1-2. Work happens when something moves or changes.
3-4. Energy has to be put into a machine before we can get work out of it.
5-6. People invent machines to do work.
7-8. There are more machines now than in the past.
9. Some of the machines we use today are more important to us than others.
10. In some countries people use fewer machines and less energy than we do.

LEVEL D for Ages 7-9

THE EARTH'S ENERGY SOURCES ARE LIMITED

1-2. Major energy sources in use today are unevenly distributed around the world and must be transported to where they are needed.
3-4. Energy sources are either renewable or nonrenewable.
5-6. Cutting consumption is a way to conserve energy.
7-8. Insulating is a way to conserve energy.
9-10. Recycling is a way to conserve energy.

LEVEL E for Ages 8-10

ENERGY CHANGES FROM ONE FORM TO ANOTHER

1-2. Energy is either waiting (potential energy) or it is working (kinetic energy).
3-4. We use some forms of energy without changing them.
5-6. Energy can be changed (converted) from one form to another to make it more useful.
7-8. There are natural and technological conversion systems.
9-10. Energy is wasted in conversion.

LEVEL F for Ages 9-11

THE ENERGY SITUATION AFFECTS MINNESOTANS TODAY

1-2. Minnesota has special energy problems.
3-4. The cost of energy has an economic impact on families.
5-6. Jobs are dependent on energy availability.
7-8. Energy use has environmental consequences.
9-10. Conservation is everybody's business.

LEVEL G for Ages 10-13

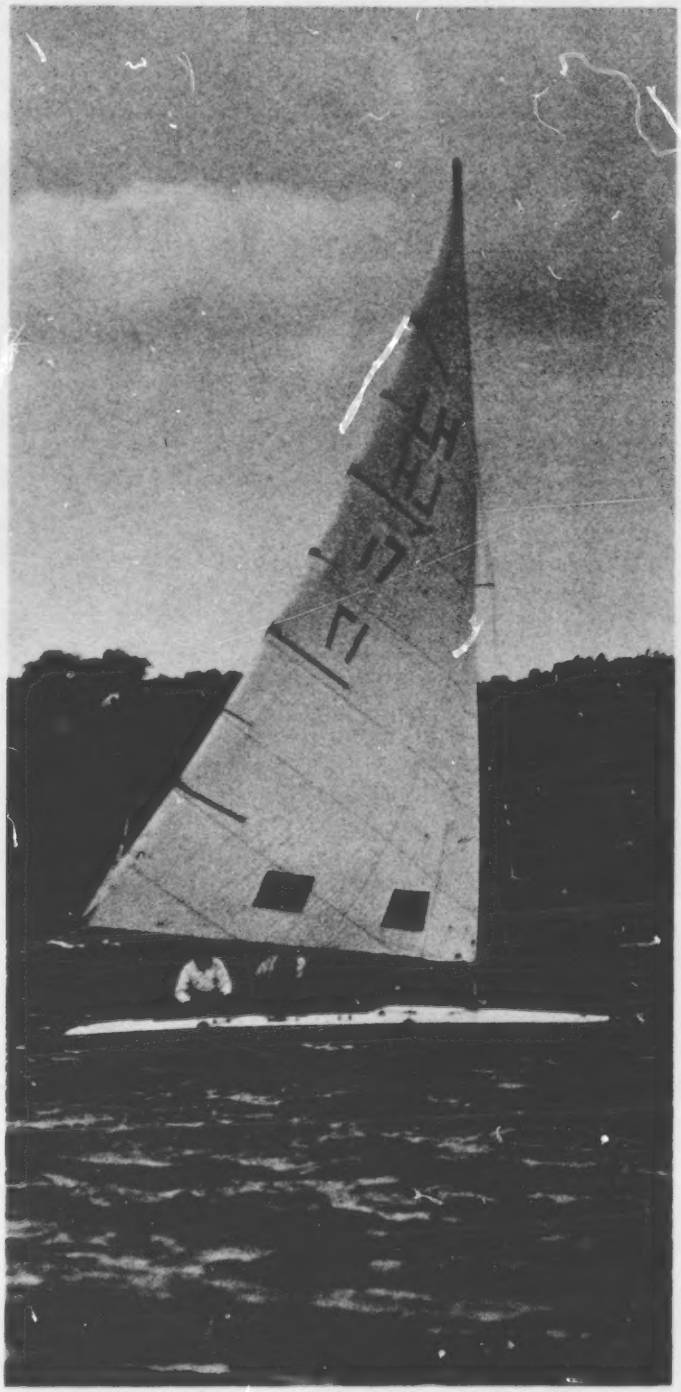
THE ENERGY SITUATION WILL AFFECT THE FUTURE

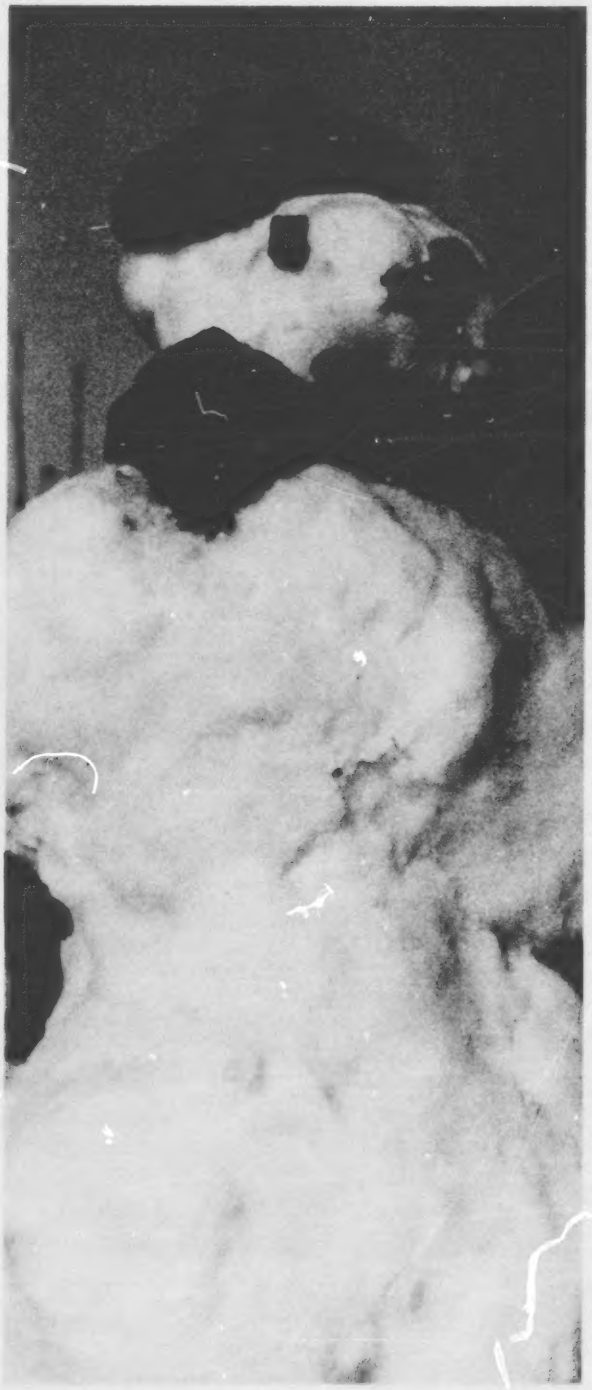
1-2. Because Minnesota's energy resources are limited, we need to look at alternative sources.
3-4. Alternative energy sources continue to be developed.
5-6. By making use of wastes, we conserve energy.
7-8. The energy situation has an international impact.
9-10. Further advances in energy-related technology will have an impact on our lives that is difficult to imagine.

A Minnesota Energy Activity

Organizing Principle For Series F: The energy situation affects Minnesotans today.

Unit 1 Concept: Minnesota has special energy problems.





How hot does it get in Minnesota? How cold?

The Big Idea

Objective: To gather and evaluate information concerning the relationship between Minnesota's geographic location and energy use.

Skills: Observing, communicating, analyzing.

Materials: Construction paper (black, white), scissors, tape, crayons, encyclopedias.

Minnesota has a wide range of temperatures, but just how hot and how cold does it get? And how do changes of the seasons affect our use of energy? Design a poster for each season to show the change in the hours of light and dark. Draw pictures or use symbols as signs of the seasons.

When are day and night the same length?

When do we have the longest day of the year? The shortest?

What does "equinox" mean?

What does "solstice" mean?

How are the winter solstice and summer solstice alike? How are they different?

How do changes in the season affect energy use?

Other Learning Activities

Work out a plan to chart the weather for one month. Graph the temperature highs and lows. Also chart the length of days and nights. (You may want to relate this activity to the meter reading activity on Card 4.)

How can you find out record high and low temperatures?

Learn to figure the "wind chill factor." (Use the "Information Card" from this series.)

What types of clothing are most effective in protecting against wind?

For the Teacher

The photograph and question on the front of this card are meant to stimulate thought about Minnesota's geographic location as it relates to the energy situation and to interest students in carrying through the learning activities.

Distance from the equator is the biggest factor in determining climate. But the warmth or coldness of a geographic area is also determined by the distribution of land and water masses.

Water warms up—and cools down—much more slowly than land. Thus oceans are usually warmer in winter and cooler in summer than the nearby land. The result is that the ocean warms the land in the winter and cools it in the summer.

Interiors of large land masses such as Eurasia and North America are affected least by the oceans. Temperature ranges there are greater than those of coastal areas and interiors of small land masses.

Minnesota's geographic location gives us a climate of extremes. We must have energy to survive the cold of winter. For comfort, we have turned increasingly to air conditioning during the summer months. Although Minnesota has wood and peat, we depend upon supplies from outside the state for almost all our fuel. On this card we begin to look at Minnesota's unique situation with regard to energy. Subsequent cards deal with our state's special problems and look toward possible solutions.

In carrying out suggested activities, have the children work in groups whenever possible. This gives them a chance to develop interpersonal skills and allows you to observe work habits.

INFORMATION CARD

We find out how cold it is in the winter by looking at the thermometer. But the thermometer reading alone doesn't tell us how cold it feels. A lot of our feeling of cold comes from the wind. The faster the wind blows, the faster our bodies lose heat. As the speed of the wind increases, so does our feeling of cold. Wind chill is an estimate of how cold the wind makes us feel. For instance, when the temperature is 10° F and the wind is blowing at a speed of 15 mph, the wind child temperature is equal to -20° F. This means that with a 15 mph wind at 10° F we feel as cold as we do when the temperature is -20° F and the wind is calm.

The wind chill measurements were developed in 1963 from experiments done in Antarctica. Wind, however, is not the only factor that makes us feel cold. A thin person or someone whose clothes are wet will lose more heat and feel colder than another person. Being aware of the wind chill reading on a given day helps us know how to dress for the weather.

WIND CHILL FACTOR

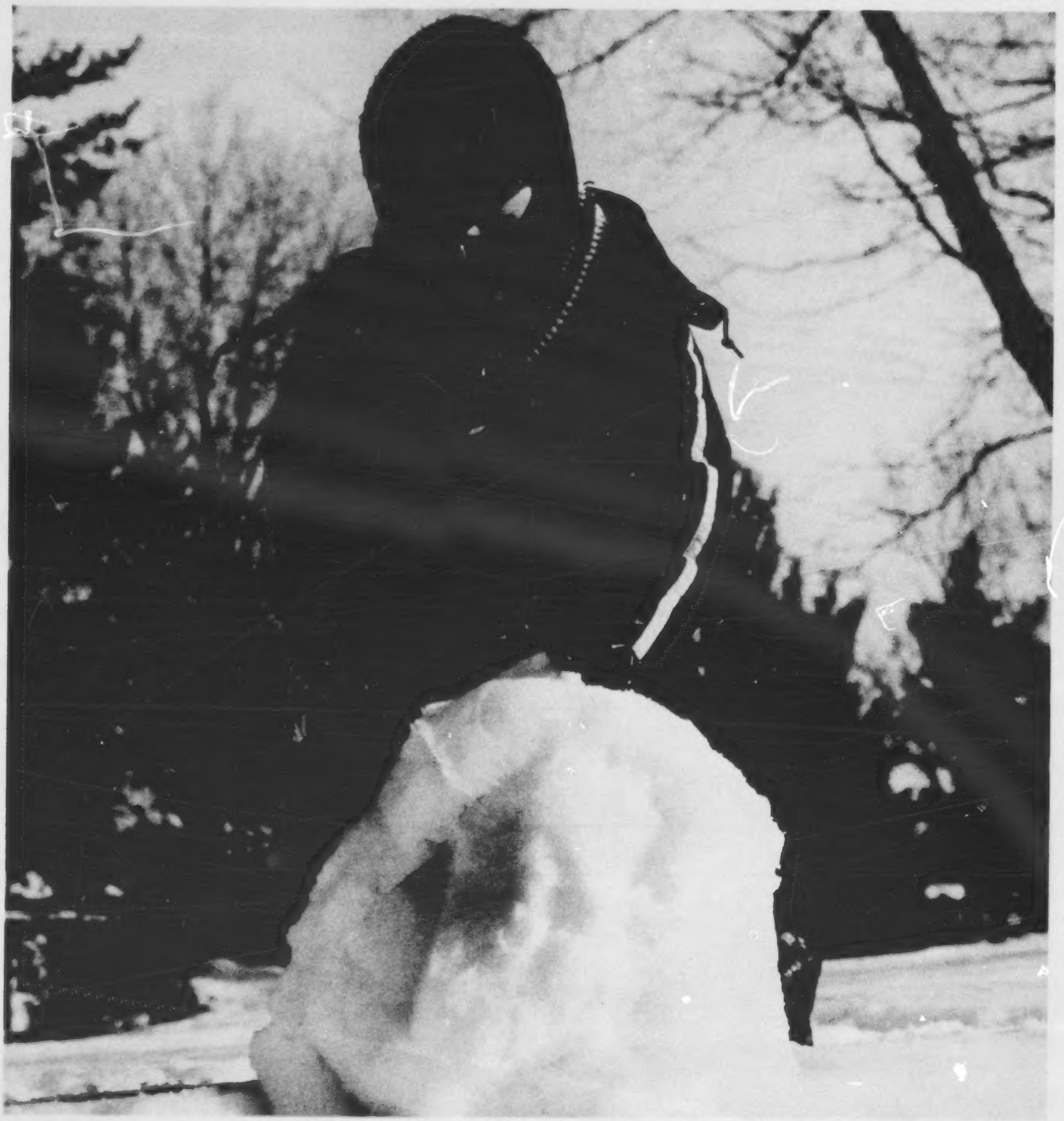
WIND SPEED	COOLING POWER OF WIND EXPRESSED AS "EQUIVALENT CHILL TEMPERATURE"																				
MPH	TEMPERATURE (°F)																				
CALM	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45	-50	-55	-60
	EQUIVALENT CHILL TEMPERATURE																				
5	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45	-50	-55	-60	-70
10	30	20	15	10	5	0	-10	-15	-20	-25	-35	-40	-45	-50	-60	-65	-70	-75	-80	-90	-95
15	25	15	10	-0	-5	-10	-20	-25	-30	-40	-45	-50	-60	-65	-70	-80	-85	-90	-100	-105	-110
20	20	10	5	0	-10	-15	-25	-30	-35	-45	-50	-60	-65	-75	-80	-85	-95	-100	-110	-115	-120
25	15	10	0	-5	-15	-20	-30	-35	-45	-50	-60	-65	-75	-80	-90	-95	-105	-110	-120	-125	-135
30	10	5	0	-10	-20	-25	-30	-40	-50	-55	-65	-70	-80	-85	-95	-100	-110	-115	-125	-130	-140
35	10	5	-5	-10	-20	-30	-35	-40	-50	-60	-65	-75	-80	-90	-100	-105	-115	-120	-130	-135	-145
40	10	0	-5	-15	-20	-30	-35	-45	-55	-60	-70	-75	-85	-95	-100	-110	-115	-125	-130	-140	-150
WINDS ABOVE 40 HAVE LITTLE ADDITIONAL EFFECT.	LITTLE DANGER					INCREASING DANGER (Flesh may freeze within 1 minute)						GREAT DANGER (Flesh may freeze within 30 seconds)									
	DANGER OF FREEZING EXPOSED FLESH FOR PROPERLY CLOTHED PERSONS																				

A MINNESOTA ENERGY ACTIVITY
(Information card to accompany
Card 1 of Series F)

A Minnesota Energy Activity

Organizing Principle For Series F: The energy situation affects Minnesotans today.

Unit 2 Concept: Minnesota has special energy problems.



How can colors help to keep you warm or cool?

The Big Idea

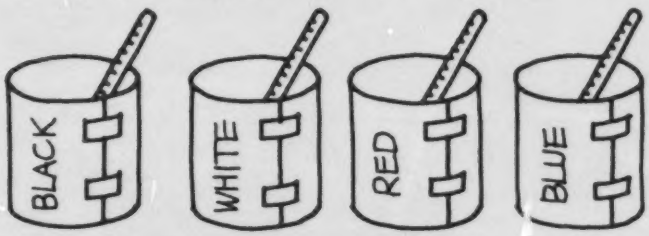
Objective: To investigate ways of adapting to Minnesota's climate.

Skills: Designing an experiment, measuring, divergent thinking.

Materials (This is a sunny day activity.): 4 cans of equal size (soup or juice cans work well), 4 thermometers, measuring cup, construction paper (black, white, red, and blue), scissors, tape, pencils, paper, water.

Form small groups to do this activity.

Tape construction paper around four cans. Fill the cans with equal amounts of cool or cold water. (Water must be the same temperature in all cans.) Put a thermometer in each of the cans and place the cans in a sunny spot.



TAPE PAPER AROUND CANS

Record the temperature every four minutes on graphs made for each can of water. Continue until the temperature is constant.

If the graphs differ, how do you explain the differences? How can you apply what you have discovered?

Could the color of the shingles you put on a house help keep it cool in the summer?

How will the paint and upholstery colors affect the comfort of a car?

Can the color of your clothing help keep you warmer in winter and cooler in summer? Develop an experiment to back up your answer.

Other Learning Activities

Plan a winter camping trip.

What will the menu include?

How will you protect yourself against the cold?

Test various weights of oil to determine how cold affects the flow of oil.

What do the results have to do with a car's starting in the winter?

Find out what people in another culture do to adapt themselves to a hot, dry climate.

What forms of energy do they use?

For the Teacher

The photograph and question on the front of this card are meant to stimulate thought about adapting ourselves to the climate and to interest students in carrying through the learning activities.

Wherever we live, our way of life is affected by the climate. It affects the kinds of houses we build, the clothing we wear, what we do for recreation, what we eat and, to some extent, what forms of transportation we use.

On this card we investigate how color can be a factor in adapting to climate. Some colors reflect heat while others absorb it. Thus if we wear something white in the sun we will be cooler than if we wear something black. Application of the reflecting and absorbing properties of color can be applied to such things as shingles and house paint.

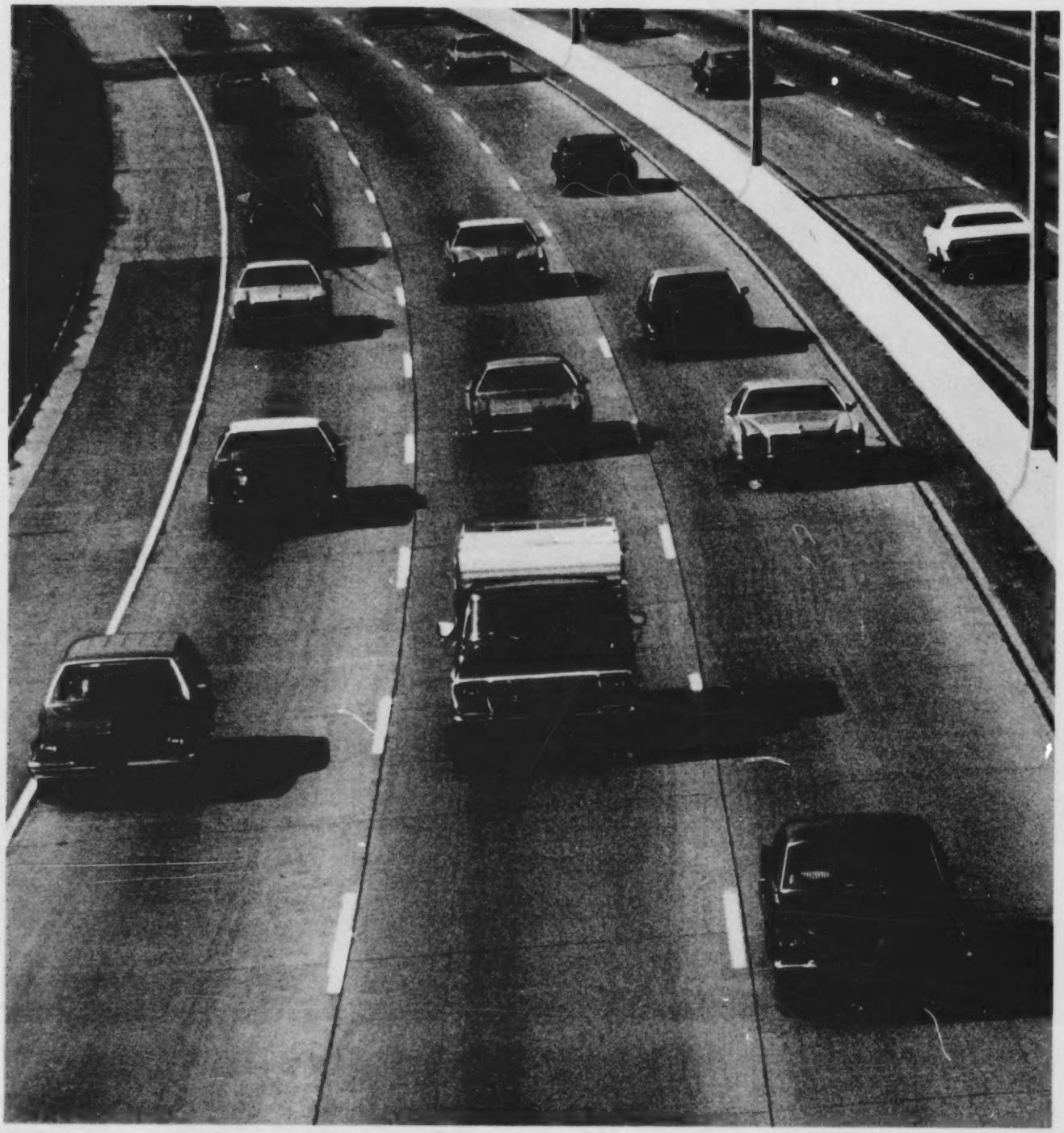
You may want to discuss the use of color in interior decorating. Colors such as orange or yellow give rooms a "warm" feel while green or blue give a "cool" feel.

The history of the human race has been one of adaptation to climate. Now that conservation of energy is crucial, it's important that we consider all the ways we can best adapt ourselves to our environment.

A Minnesota Energy Activity

Organizing Principle For Series F: The energy situation affects Minnesotans today.

Unit 3 Concept: The cost of energy has an economic impact on families.



The Big Idea

Objective: To determine the cost of energy required to operate a car.

Skills: Communicating, gathering and analyzing data, evaluating.

Materials: Pencils, paper, hand calculator (optional).

For this activity you need the cooperation of someone who drives a car. You will need to find out:

1. The mileage that appears on the car's odometer when the gas tank is full. The tank was full at _____ miles.

2. The mileage that appears on the odometer the next time the tank is filled. The tank was refilled at _____ miles.

3. How many gallons it took for a refill. It took _____ gallons of gas for a refill.

4. The cost of the gasoline used to refill the tank. The gas cost _____ per gallon.

Use this information to figure the miles per gallon (mpg). Then calculate how much it costs to drive a car one mile.

Do the costs seem like a little or a lot? (Next think of a way to find out how many miles the car is driven in an average year.)

How much would the gas cost to run the car for one month? For a year?

Other Learning Activities

Keep a log of the car trips a family makes. If possible, record the miles for each trip. Try to keep the log for at least one week.

What trips would you cut out if your family had enough gas to drive only half as many miles?

Compare the transportation expenses of someone who owns a car and someone who doesn't.

How does the person without a car get from place to place?

For the Teacher

The photograph and question on the front of this card are meant to stimulate thought about the energy used by cars and to interest students in carrying through the learning activities.

If you simply want to teach how to compute gas mileage, you might prefer to set up a hypothetical situation involving a school car or bus.

Figuring gas mileage for the family car is not intended as a contest to see who uses the most or least gasoline. Any comparison or competition should be within the individual families to see if they can cut back on consumption.

A 1979 study revealed that it cost 38¢ per mile to own and operate a new intermediate-size car. Gasoline makes up only part of that figure, but as the price of gas rises, it is an increasingly significant factor in the overall cost of transportation. Children can help their families conserve gasoline by planning ways to consolidate shopping trips. When possible, they can walk, ride a bike, or arrange car pools.

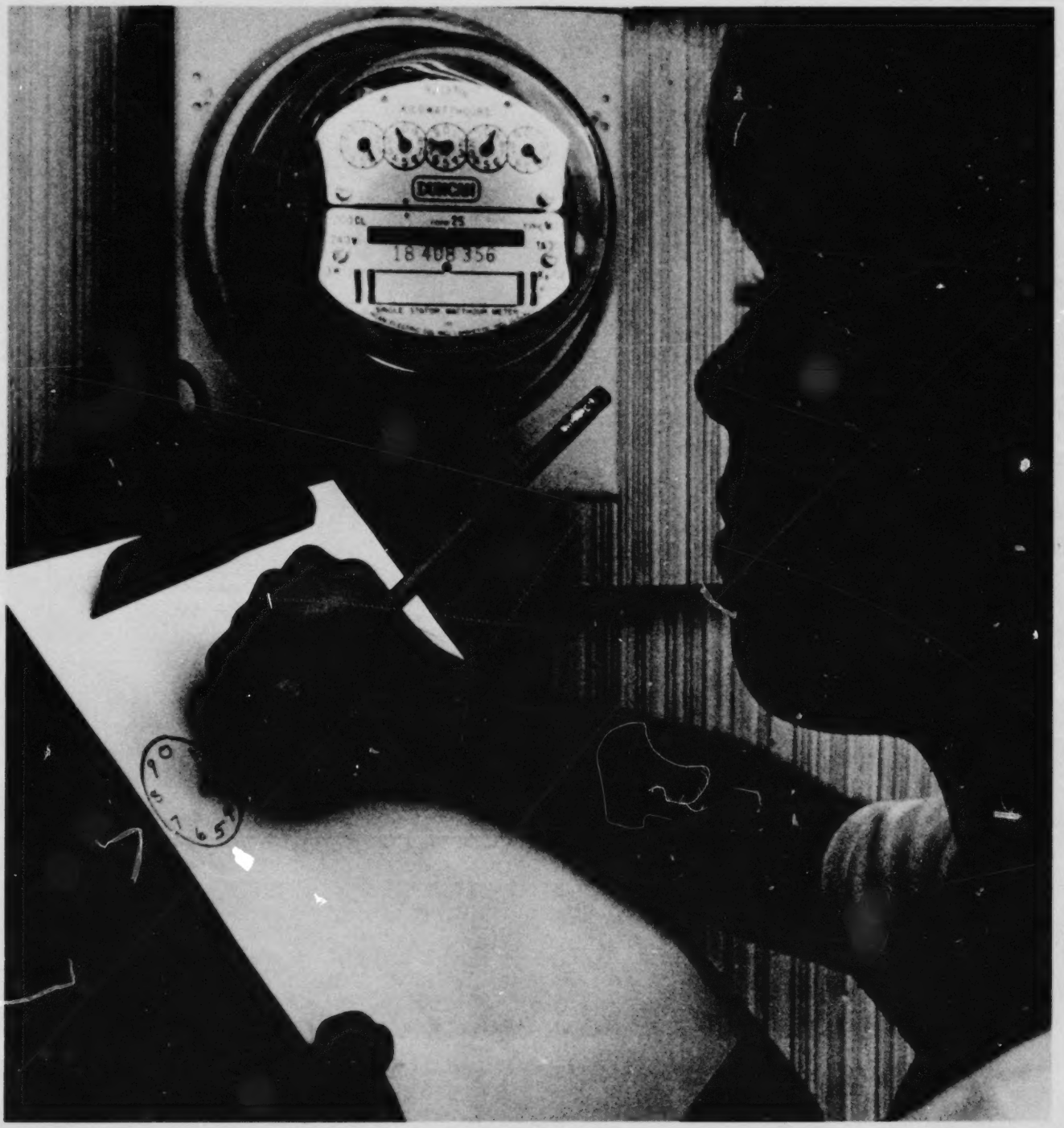
Whatever is saved benefits the family budget as well as the national energy picture. According to the Federal Energy Administration: "If the fuel consumption of the average car were reduced just 15% . . .the nation's consumption of petroleum would fall by over 28,000,000 gallons per day. (To give students an idea of how much 28 million gallons is, have them do a little math to figure out how many classrooms those gallons would fill.)

A Minnesota Energy Activity

Organizing Principle For Series F: The energy situation affects Minnesotans today.

Unit 4 Concept: The cost of energy has an economic impact on families.

Series F Card 4



How do you read a meter?

The Big Idea

Objective: To determine the amount of energy used in the home.

Skills: Observing, gathering and analyzing data.

Materials: Pencils, paper, hand calculator (optional), old utility bills.

The dials on an electric meter show how much electricity has been used. To read the meter, record the number the pointer is on. If the pointer is between two numbers, *always* record the smaller number.

The reading on this dial is "1."

The reading on this dial is "7".

Record the reading of your home or school electric meter. Do it at about the same time every day for one week.

On which day was the most electricity used? The least?

How do you explain the difference?

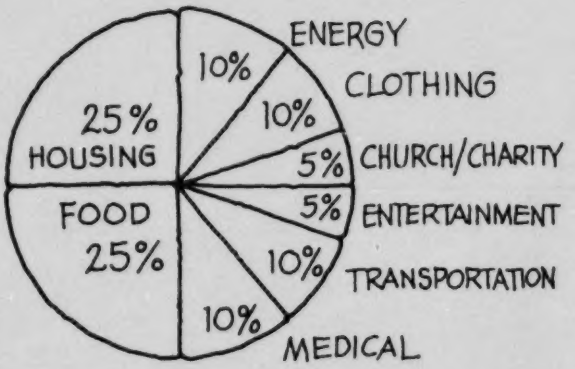
You may want to do this activity over a longer period of time and chart the affect that the change of season has on energy usage.

Other Learning Activities

Look at an actual electric bill. Find out what kwh (kilowatt-hour) means. Use the kwh rate to figure the cost of electricity at your home or school on those days when you read the meter.

Compute your family's energy costs for one month. What happens to a family's budget when costs rise?

Interview retired people to find out how they handle price increases.



This is one family's budget. As energy costs rise, where do you think the budget will change?

What if the electricity in your community were to be shut off for 8 out of 24 hours every day? Which 8 hours do you think they should be? How would your family cope with the situation?

For the Teacher

The photograph and question on the front of this card are meant to stimulate thought about energy used in the home and to interest students in carrying through the learning activities.

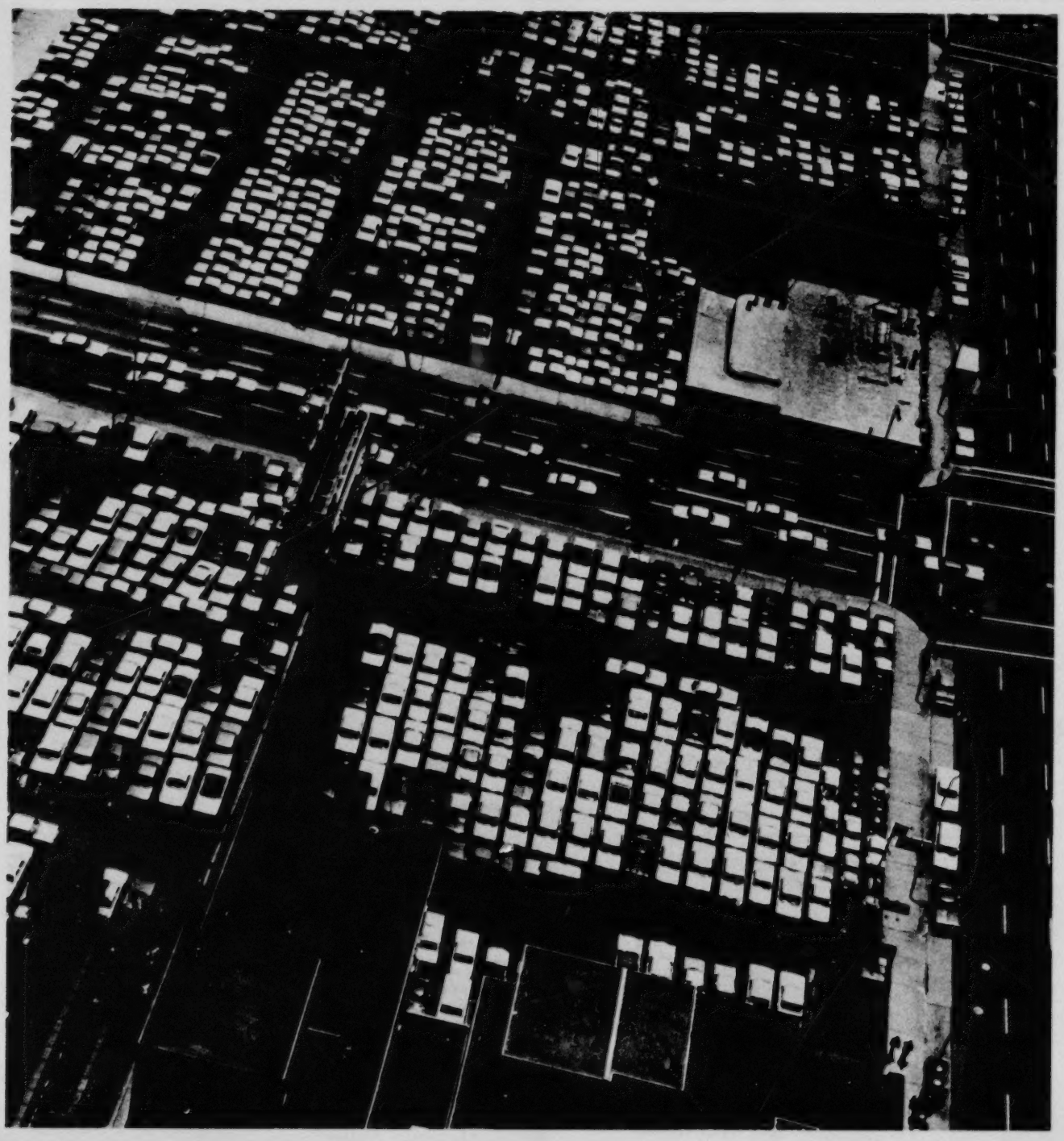
Every family is aware that energy costs have risen dramatically in the past few years. In 1970, the average family spent about 5% of its income on energy. By the late '70s, the figure was close to 10%. It's estimated that by 1990 a family will have to spend about 20% of its income—or one dollar in five—for natural gas, electricity, heating oil, and gasoline.

As energy costs continue to rise, families will have to budget their use of energy much the way they now budget their money. By involving children in reading utility meters, we heighten their understanding of energy use patterns in the home. When children see the direct relationship between the amount of energy used and the cost to the family, they may be motivated to change any energy-wasteful habits they know about and urge others in the family to do the same.

A Minnesota Energy Activity

Organizing Principle For Series F: The energy situation affects Minnesotans today.

Unit 5 Concept: Jobs are dependent on energy availability.



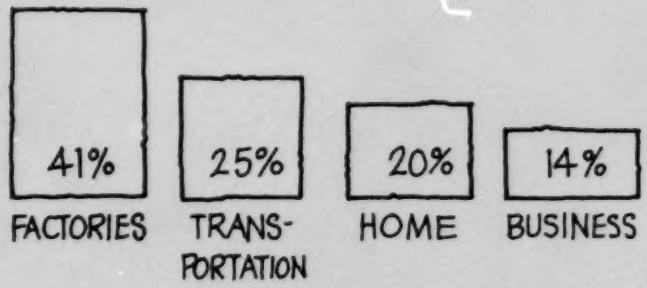
The Big Idea

Objective: To be aware of the energy consumption pattern in the U.S.

Skills: Observing, gathering and analyzing data, divergent thinking.

Materials: Pencils and paper.

The United States has less than 7% of the world's population but uses over 35% of the energy. Here is a graph that shows the ways we use that energy.



Much of the energy used for transportation goes into the cars and trucks we see on the highways. Divide into teams and develop a plan for taking a traffic survey somewhere near your school. You might want to design a survey that will answer one or more of these questions:

- Is there more traffic at one time off day than another?
- What is the average number of riders per vehicle?
- Are there more big or small cars? (You decide what "big" and "small" mean.)
- What can you tell about jobs from observing names on cars and trucks?

Other Learning Activities

Create an advertising campaign that is meant to sell the benefits of driving less and car-pooling more.

As a member of your Town Council, you must help decide when to turn off the electricity 8 hours per day for one month. Your goal is to keep as many people working as possible.

Suppose there was a world court to make decisions about the world's energy situation. You must appear before the court and explain why the U.S. uses so much energy. What would you have to say?

For the Teacher

The photograph and question on the front of this card are meant to stimulate thought about this country's energy consumption and to interest students in carrying through the learning activities.

In 1900, Americans used only about 25% of the energy we consume today. As the years passed, there were more and more people using increasing amounts of energy. If the population and demand for energy increase at their present rate, we will—by the year 2000—use almost twice the amount of energy we do today.

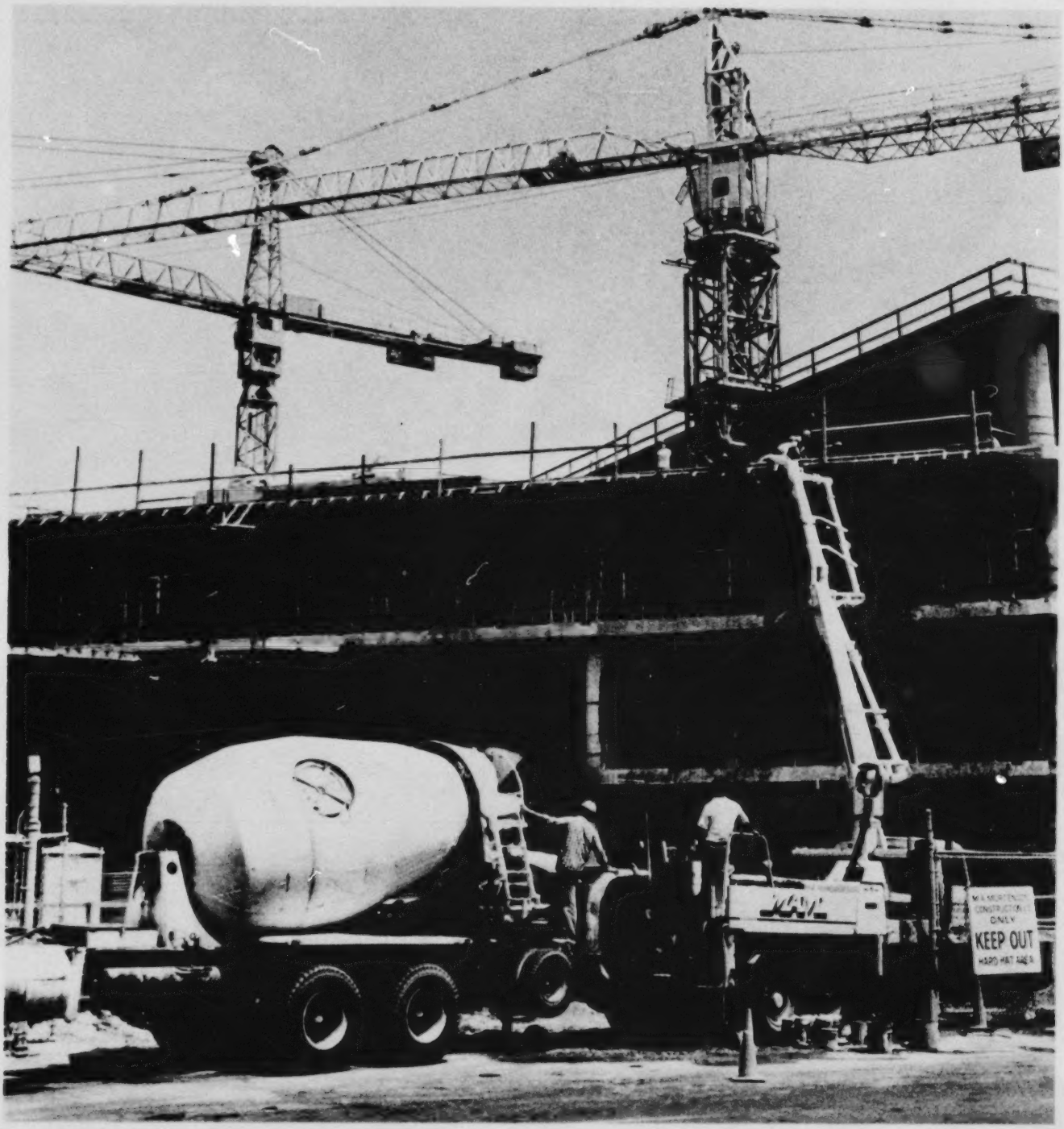
It's widely believed that we need at least as much energy as we now use to maintain our present standard of living. But do we? Sweden and Switzerland have living standards comparable to ours yet use only half the energy we do.

Half the energy we use is wasted. Simply by cutting back on waste, we can make the known reserves last longer. This "buys time" to develop alternative sources. Some researchers feel that we can make the transition from our heavy dependency on fossil fuels to other sources without seriously altering our present level of productivity and employment. Others are much less optimistic. The actions we take as individuals and as a nation during the 1980s are of vital importance in deciding what the quality of life will be.

A Minnesota Energy Activity

Organizing Principle For Series F: The energy situation affects Minnesotans today.

Unit 6 Concept: Jobs are dependent upon energy availability.



How is energy used by workers?

The Big Idea

Objective: To discover how workers in specific jobs depend upon energy to do their work.

Skills: Communicating, analyzing.

Materials: "Help Wanted" advertising pages from both a metropolitan and a small town newspaper, paper, crayons, tape or glue.

Read through some "Help Wanted" ads until you find a job description that is of some interest to you. Cut out the ad and fasten it to a piece of paper that is large enough to include a drawing. On the same paper, list all the ways the person doing this job uses energy. Then draw a picture showing this person at work.

- How would this worker's job be affected if there were a coal strike?
- How would a cutback in the availability of electricity affect this worker?
- How would this worker be affected by a severe oil shortage?

Other Learning Activities

Invite a farmer, grocery store manager or food distributor to your classroom to tell you the ways in which energy is important to food producers.

Create a mural that shows all the workers involved in bringing a particular food—such as milk—from the source to the consumer. Be able to identify the energy each worker requires.

Prepare questions and use a tape recorder to interview one of the oldest people you can find.

- What were the most common jobs in those long ago days?
- What were the sources of energy used to do those jobs?
- How has the increased use of machines changed those jobs?
- What practices from the past could we apply to our lives today to help us conserve energy?

For the Teacher

The photograph and question on the front of this card are meant to stimulate thought about energy as it relates to jobs and to interest students in carrying through the learning activities.

Factories and businesses account for about one-half of all the energy that is used in this country. Knowing this, we can see that any major change in availability of energy will have an impact on large numbers of people.

In discovering more about specific jobs and the energy they require, children can begin to see how dependent workers are on an uninterrupted flow of energy to power typewriters and tractors, photo copiers and x-ray equipment. But beyond this, they should also see that we live in an interdependent society.

The basic needs the farmers of Minnesota have for energy—especially during planting and harvesting—is an example of interdependence. If there is less energy to run farm machinery, the supply of food is affected. This, in turn, causes higher food prices which may lead people to change their buying habits. For example, people may buy less beef. Then those involved in the meat industry may face unemployment. It is rather like the ripples moving outward from a stone dropped in water.

A Minnesota Energy Activity

Organizing Principle For Series F: The energy situation affects Minnesotans today.

Unit 7 Concept: Energy use has environmental consequences.

Series F Card 7

What happens to all the wrappings?

The Big Idea

Objective: To investigate waste in packaging.

Skills: Analyzing, evaluating, communicating.

Materials: Construction paper, crayons or watercolor markers.

Just about everything we buy—from candy bars and chicken to records and nails—comes in wrapping we throw away. Most of us carry our purchases from the store in yet another wrapper—a paper or plastic bag. Some people believe that if we had to pay a deposit on certain containers that we now throw away, we would return them for reuse and thus conserve energy.

Divide into teams and pretend that you are lobbyists appearing before the state legislature. One team is to lobby "for" a deposit on all soft drink bottles and cans. The other team is "against" the idea. Make signs to display for media coverage. Each team must select a representative who will have three minutes in which to make a presentation of the group's ideas.

How does a society decide what items should or shouldn't require deposits?

How might legislation concerning deposits affect jobs?

Other Learning Activities

Create a packaging display that includes what you consider to be examples of both necessary and unnecessary packaging. Discuss how packaging influences buyers. Consider a man's shirt hung on a hanger as opposed to the same shirt pinned around cardboard and covered with plastic.

What kind of merchandising do you think is most appealing to customers? Why?

Contrast the packaging of food in a U.S. supermarket with packaging of food in an open air market.

Much of the food we buy is dated and cannot be sold after the expiration date. How does such dating contribute to food and packaging waste?

For the Teacher

The photograph and question on the front of this card are meant to stimulate thought about waste in packaging and to interest students in carrying through the learning activities.

It is calculated that the average American creates about 4 ½ pounds of trash each day. Much of what we throw away is packaging. We should be raising values questions that stimulate creative thought. Are frozen foods in plastic cooking pouches worth their energy costs? Is there a better way to make use of packaging wastes than as landfill?

In many foreign countries there is much less packaging of foods and other goods than in this country. If you know someone who has visited a foreign country, invite this person to tell the class about his or her experiences with packaging.

One of the most frequently noted kinds of waste is the no-return bottle. (Buying six soft drinks in returnable bottles instead of throwaways saves the energy equivalent of about .25 liters of gasoline.) A significant effort is being made to recycle metal throwaway containers. This suggests there are partial answers to waste in packaging.

When discussing waste, it is important not to limit concern to one industry or group. There is virtually no area of life—industrial or private—in which some packaging waste couldn't be eliminated if we only made the effort.

A Minnesota Energy Activity

Organizing Principle For Series F: The energy situation affects Minnesotans today.

Unit 8 Concept: Energy use has environmental consequences.

Series F Card 8

How clean is the snow?

The Big Idea

Objective: To be aware that everything that is done to meet our energy needs has an impact on the environment.

Skills: Designing an experiment, observing, analyzing.

Materials: 2 pails of snow, red and blue litmus paper, funnel, filter paper (a coffee filter works), microscope (optional).

This activity should be carried out right after a fresh snowfall. Fill a clean pail with fresh snow and label it as such. Fill another clean pail with snow that has been on the ground for a few days or weeks.

Bring the pails indoors. After the snow melts, observe the contents and record your findings. Test with litmus paper. Filter the water from each pail. Observe drops of water with a microscope.

How clean is the snow?

What other tests could be made?

Can you tell what impurities in the snow may have come from the use of energy?

Other Learning Activities

Acid rain is a by-product of air pollution. It is precipitation from either rain or snow in which the water has a greater than normal acidity. The major causes of the high acidity are sulfur dioxide and nitrogen oxide which are given off by industrial smokestacks. Acid rain is not considered to be a threat to humans. It is, however, believed to reduce productivity of forests, and to contribute to the deterioration of buildings and statues.

What impact might acid rain have on Minnesota's tourist industry?

How might acid rain affect our use of wood as a source of energy?

Write a play that has polluted water and polluted air as main characters.

Do some research to find out what is happening to the nuclear wastes produced by Minnesota's nuclear power plants. We know that great caution must be taken with these deadly materials that remain so for an extremely long time. Write a class letter to the utility company that serves your area to find out what it has to say about nuclear wastes.

For the Teacher

The photograph and question on the front of this card are meant to stimulate thought about the environmental impact of energy use and to interest students in carrying through the learning activities.

The greater our use of energy, the more we pollute our environment. Whatever we burn sends pollutants into the air. Some fuels burn cleaner than others. Wood, natural gas, and fuel oil, for instance, pollute less than coal. Environmentalists have worked to limit the amount and grades of coal that can be burned. But, as other fossil fuels become more scarce, standards are apt to be relaxed and greater allowance made for use of coal with a high sulfur content.

Some of the fuel by-products we now have to contend with are airborne particles, gases, noise, heat, radio-active waste. These will also be very much a part of our future. Children need to realize that there are few easy solutions and many perplexing questions about such issues as the routing of power lines and the building of power plants. In the end, there must be trade-offs and each decision that is made will affect the environment and our lives.

A Minnesota Energy Activity

Organizing Principle For Series F: The energy situation affects Minnesotans today.

Unit 9 Concept: Conservation is everybody's business.

Series F Card 9

Which is the better buy?

The Big Idea

Objective: To develop the ability to be an energy-conscious shopper.

Skills: Designing an experiment, gathering data, evaluating.

Materials: 2-3 pairs of new flashlight batteries (D cells of different brands and prices), 4-6 flashlight bulbs, insulated wire, knife, tape, photographer's light meter (optional).

Divide into groups so that each group has one battery and bulb and can use the other materials as needed. Imagine now that you're spelunkers who will be spending many hours exploring caves. You need batteries you can depend on. Set up a test to find out how many hours of light are in a battery.

What was the cost of the battery?

How much did an hour of light cost?

All experimenting groups should compare results.

Did batteries of the same brand give the same number of hours of light?

If there were differences, how can they be explained? (Note: If you have a light meter, you can also measure and graph the change in brightness.)

Other Learning Activities

Work out a survey to find out what people are most concerned about when they go shopping for a car.

Is it price?
Miles per gallon?
Style?
Roominess?
Color?
Other?

The refrigerator is an important appliance that serves us 24 hours a day. It lasts for years, but when it breaks down we want a replacement in a hurry. Put together information on various refrigerators from catalogs and other advertising. Look in the library for "shopping guides" and magazines such as *Consumer's Report* to find out the kilowatt-hour (kwh) ratings.

On the basis of research, what refrigerator would you buy?

For the Teacher

The photograph and question on the front of this card are meant to stimulate thought about energy-conscious shopping and to interest students in carrying through the learning activities.

One important way that all of us can conserve is to become energy-conscious shoppers. It takes energy to provide everything that is manufactured. If we purchase those items from which we believe we will get the *most* wear or use, the energy used to produce them will have been used to good advantage.

By the time children reach the upper elementary grades they have more opportunities to earn money and spend it as they wish. If they start becoming energy-conscious shoppers at an early age, chances are good that they will develop a conservation ethic.

As children become older, they are likely to be included in decision-making when the family purchases such items as TV sets and refrigerators. Those children who have been involved in energy education might even be in a position to alert their parents to kilowatt hour (kwh) listings and to refer them to shopping guidelines such as those found in government ratings and consumer publications

A Minnesota Energy Activity

Organizing Principle For Series F: The energy situation affects Minnesotans today.

Unit 10 Concept: Conservation is everybody's business.

112

What can we do to conserve energy at home?

The Big Idea

Objective: To apply the conservation ethic at home.

Skills: Communicating, evaluating.

Materials: Poster-making materials, plus copies of the "Home Energy $aver$" sheet which is included on an "Information Card" in this series.

Think about the many ways you use energy in your home. Then make up a conservation slogan that you believe would be helpful in reminding your family to use energy wisely.

Turn your slogan into a poster. Plan the poster so that you can work in a "Home Energy $aver$" sheet.

Take your poster home and display it where every member of your family will see it.

Other Learning Activities

Brainstorm with other members of your class to develop a list of ten *Practical* things people in your community could do to cut down on their use of energy. Print these ideas in a newsletter and distribute it to friends and neighbors.

Invent a tool to check for winter drafts around windows, doors, and electrical outlets. Try doing it with only these materials: pencil, paper, tape, thread, scissors.

Find and interview a person who can tell you what farm life was like without electricity.

For the Teacher

The photograph and question on the front of this card are meant to stimulate thought about the conservation of energy at home and to interest students in carrying through the activities.

Although conservation does not provide us with more coal, oil, or natural gas, we sometimes hear people speaking of conservation as an energy source. What they mean is that conservation provides us with a means of making the energy that we do have go further. There is also another point in favor of conservation and that is the savings that might be brought about.

Consider for a moment a future in which a synthetic fuel may cost anywhere from $30-50 per barrel. Such costs suggest that a carefully planned program of conservation might make it unnecessary to produce that very expensive fuel in such massive quantities. We might find that an insulation project done on a national level could cut consumption. It could be that for every $30-50 spent on insulation there would be a barrel of oil saved every year. Thus, insulation would be a wise investment indeed!

Individual actions which children take may not save a great deal of energy in the short run. However, over a period of years the conservation ethic will pay off for all of us. The careful thinking that goes along with conservation plans may also prevent us from stampeding toward what appears to be the quickest solution. The energy dilemma will be with us for some time. Conservation is a basic first step toward a resolution.

INFORMATION CARD

HOME ENERGY $AVER$

1. Dust the lightbulbs. (Dust robs you of 1/3rd of the light.)
2. Turn the lights off whenever you leave a room.
3. Take short showers and conserve both water and energy.
4. Repair faucet drips. (One drop of hot water per second wastes 100 gallons—378.5 liters—a month.)
5. Weatherstrip doors. (Just one narrow crack under a door can cost you $5 during the heating season.)
6. Caulk around all windows and doors and vents.
7. Ventilate the attic. (Wind-powered ventilators use free wind energy.)
8. Pull shades and drapes when the air conditioning is on.
9. Vent the electric clothes dryer into the house in winter. (But watch for humidity buildup.)
10. Lower the thermostat during sleeping hours.
11. Recycle newspapers, glass, and metal.
12. Wash only full loads of clothes in the washing machine.
13. Change furnace filters about once a month, and keep the air conditioner clean.
14. Unplug the "instant on" TV sets at night.
15. Clean the lint filter for every load of clothes dried.
16. Add an insulating coat to the hot water heater. (But be sure air can reach the flame on gas heaters.)
17. Set the water heater down to 150 F (63 C) or lower.
18. Get electronic ignition on a new stove, furnace, or water heater.
19. Comparison shop the kwh rating of every major appliance you buy.
20. Wash only full loads in your dishwasher and do so after 8 p.m.
21. Avoid opening the oven door to peek in. (Doing so lets about 20% of the heat out.)
22. Defrost when there's 1/4" (.635 centimeter) of frost in the refrigerator or freezer.
23. Make sure the next car you buy gets better mileage than your last car.
24. Open curtains on the south side of your home on sunny winter days.
25. Keep informed about new energy saving devices.
26. Check the attic insulation. Add more if necessary.
27. Dress for the weather.
28. Carpool or walk to more places than you used to.
29. Ride a bike.
30. Plant trees and shrubs to shelter your house from winter wind and summer sun.

A MINNESOTA ENERGY ACTIVITY
(Information card to accompany
Card 10 of Series F)

Minnesota Energy Activities

For Elementary Students

Minnesota Department Of Education
Minnesota Energy Agency

LEVEL A for Ages 4-6

WHAT IS ENERGY? WHAT DOES ENERGY DO? WHERE DOES ENERGY COME FROM?

1. Energy is the "go" of things.
2. Our bodies need energy. Energy comes from the food we eat.
3. Energy moves things. The energy to move things comes from many sources.
4. Energy lights things. There are many sources of light.
5. Energy heats things. There are many sources of heat.

LEVEL B for Ages 5-7

WE FIND ENERGY IN MANY PLACES

1. We get energy from the sun.
2. We get energy from the wind.
3. We get energy from water.
4. We get energy from wood, coal, oil, and gas.
5. We use the energy of electricity.

LEVEL C for Ages 6-8

ENERGY DOES ALL THE WORK IN THE WORLD

1-2. Work happens when something moves or changes.
3-4. Energy has to be put into a machine before we can get work out of it.
5-6. People invent machines to do work.
7-8. There are more machines now than in the past.
9. Some of the machines we use today are more important to us than others.
10. In some countries people use fewer machines and less energy than we do.

LEVEL D for Ages 7-9

THE EARTH'S ENERGY SOURCES ARE LIMITED

1-2. Major energy sources in use today are unevenly distributed around the world and must be transported to where they are needed.
3-4. Energy sources are either renewable or nonrenewable.
5-6. Cutting consumption is a way to conserve energy.
7-8. Insulating is a way to conserve energy.
9-10. Recycling is a way to conserve energy.

LEVEL E for Ages 8-10

ENERGY CHANGES FROM ONE FORM TO ANOTHER

1-2. Energy is either waiting (potential energy) or it is working (kinetic energy).
3-4. We use some forms of energy without changing them.
5-6. Energy can be changed (converted) from one form to another to make it more useful.
7-8. There are natural and technological conversion systems.
9-10. Energy is wasted in conversion.

LEVEL F for Ages 9-11

THE ENERGY SITUATION AFFECTS MINNESOTANS TODAY

1-2. Minnesota has special energy problems.
3-4. The cost of energy has an economic impact on families.
5-6. Jobs are dependent on energy availability.
7-8. Energy use has environmental consequences.
9-10. Conservation is everybody's business.

LEVEL G for Ages 10-13

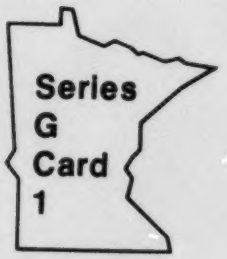
THE ENERGY SITUATION WILL AFFECT THE FUTURE

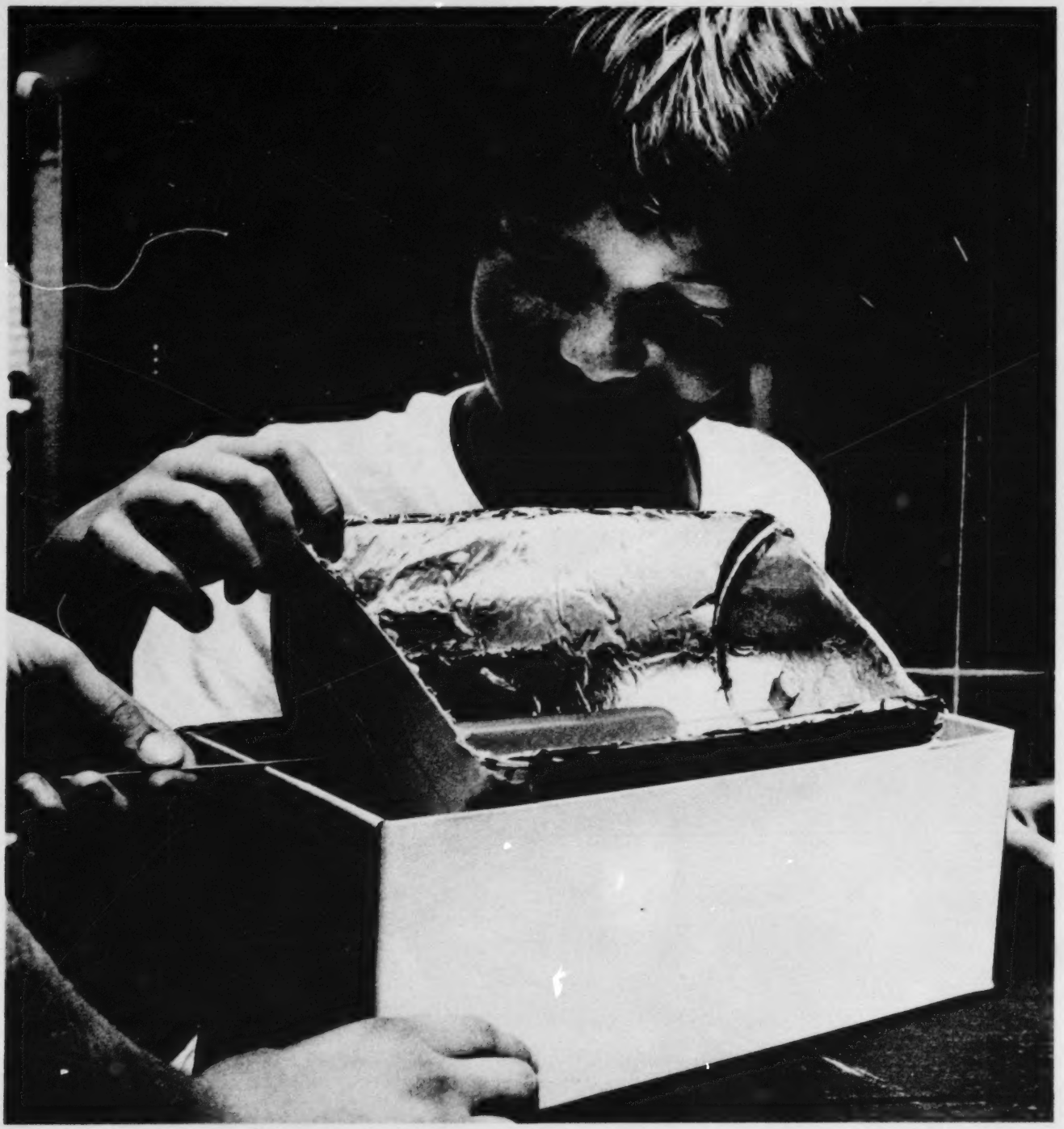
1-2. Because Minnesota's energy resources are limited, we need to look at alternative sources.
3-4. Alternative energy sources continue to be developed.
5-6. By making use of wastes, we conserve energy.
7-8. The energy situation has an international impact.
9-10. Further advances in energy-related technology will have an impact on our lives that is difficult to imagine.

A Minnesota Energy Activity

Organizing Principle For Series G: The energy situation will affect the future.

Unit 1 Concept: Because Minnesota's energy resources are limited, we need to look at alternative sources.





1 How can we use the sun's energy for cooking?

The Big Idea

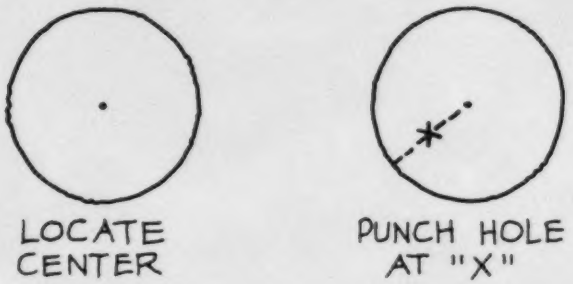
Objective: To explore the energy potential of sun, wind, and water.

Skills: Designing an experiment, observing.

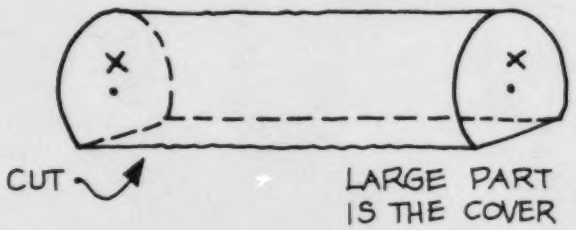
Materials: Oatmeal container, aluminum foil, rubber cement, ruler, pencil, scissors, unpainted wire coathanger, shoebox, wire cutter, hot dog.

Sun, wind, and water are three of Minnesota's potential sources of energy in the future. Although the sun sends abundant energy to the earth, collecting and storing that energy is a problem. You can make your own solar cooker to find out how useful the sun is.

1. Locate the center on both ends of an oatmeal carton. Mark a point halfway along the radius on both ends and punch a small hole there.



2. Cut the carton in two parts.



3. Line the inside—including the ends—with foil. Have the shiny side showing. Keep foil as wrinkle-free as possible. Fasten the foil with rubber cement.

4. Make a skewer from a hanger. Put on a hotdog and set your solar cooker in the sun. (Use a shoebox for a stand. See photo on front.)

Where do you place your cooker in relation to the sun?

How long does it take for the hot dog to cook?

What is the best time for solar cooking?

Other Learning Activities

Build solar collectors.

Design a wind-powered machine that will lift a penny 15 cm (6").

Make a dam to show that stored water is a source of energy. (Build your model in a box lined with plastic.)

Do any of Minnesota's rivers provide hydroelectric power?

Visit a dam or contact a college or university to see if they have a model you could plan to see on a field trip.

For the Teacher

The photograph and question on the front of this card are meant to stimulate thought about Minnesota's future energy resources and to interest students in carrying through the learning activities.

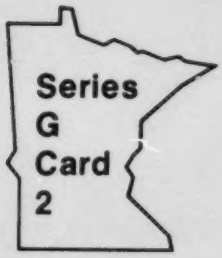
Although the sun is not often directly overhead in Minnesota, we can get considerable energy from solar radiation measured at the angle of the sun's rays. In January, a solar collector in Minnesota which faces south at a 45° angle receives only about 30% fewer BTUs per square foot than does a collector in the Mohave Desert set at a 32° angle.

One researcher maintains that Minnesota's electrical needs could be taken care of by some 50 square miles of solar collectors. Other researchers are much less optimistic, but all agree that solar energy can play an important role in Minnesota's future.

At present, hydroelectric power does not play a major role in Minnesota's energy picture. But as new technology is developed and all energy costs continue to rise, our rivers may be more widely utilized.

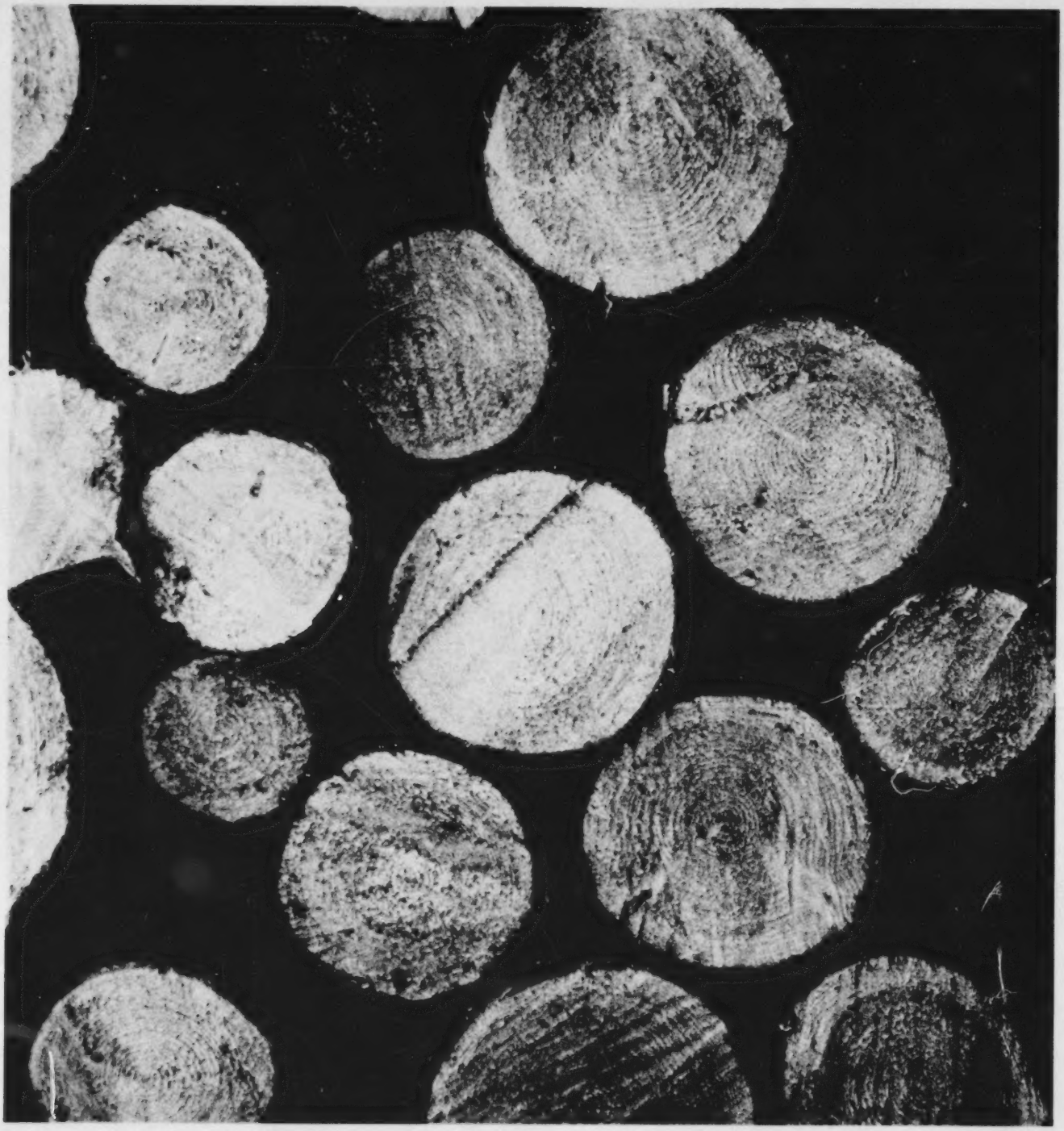
Wind is also an energy source that we can put to greater use. Two areas where wind might be used effectively are western Minnesota and the shoreline along Lake Superior. Wind could conceivably supply 20% of the state's needs in the future. However, much work is still to be done to find effective ways to utilize wind.

A Minnesota Energy Activity



Organizing Principle For Series G: The energy situation will affect the future.

Unit 2 Concept: Because Minnesota's energy resources are limited, we need to look at alternative sources.



How much heat is there in wood?

The Big Idea

Objective: To compare organic fuels.

Skills: Designing an experiment, gathering data, evaluating, communicating.

Materials (Do the burning part of this activity outside.): Charcoal grill or hibachi, juice cans, postage scale, thermometer, measuring cup, water, matches, pencil, paper, wood shavings, charcoal, cattails, corncobs, peat (available at garden stores).

Organic materials such as wood, charcoal, peat, cattails, and corncobs are sources of heat energy. Set up an experiment to find out how much heat energy there is in these materials. One way heat energy can be measured is by temperature change.

1. Fill several small cans of the same size about half full of equal amounts of water. (Water should be the same temperature in all cans when you begin.)
2. Weigh the materials to be burned. Thirty grams—or one ounce—will be enough.
3. Set up the grill to contain the fire.
4. Light the fuel. As soon as you do, remove the match and place a thermometer in a can of water over the fire.
5. Which material heats the water in the shortest amount of time? How will you record what you are doing? Are you testing for properties other than heat energy? What about the amount of smoke? How well does each material burn?
6. When testing is completed, discuss the role of cost, availability, and portability of these fuels.

Other Learning Activities

Gather information about peat. (A Series G "Information Card" shows the location of peat in Minnesota.)

What is peat?

Where is peat found?

How is peat now used as an energy source?

How might peat be used in the future?

Write a factual story about the origin of peat and the uses made of it. You might begin with the words: "I am a peat bog. . ."

For the Teacher

The photograph and question on the front of this card are meant to stimulate thought about organic materials that can be used as fuel and to interest students in carrying through the learning activities.

Since earliest times, wood has been a source of energy in Minnesota. Increasing attention is being given to the intensive planting and management of large tracts of fast-growing, adaptable varieties of trees that can be used as fuel.

Raising cattails on a large scale is also looked at with interest. Where managed stands of cattails have been cultivated, they produced approximately 35 tons of dry matter per acre. Cattails yield about 7500 BTUs per pound.

Peatlands cover about 14% or our state's total land area. Several plans are being considered to develop this resource of partially decayed plant matter and the first stage in the formation of coal. Peat might be processed into synthetic natural gas or be used as a fuel for power plants.

If peat is to be obtained in large quantities, the effect on the environment is a big consideration. Environmentalists contend that a large scale removal of peat will alter drainage patterns. There is still much that is unknown about the relationship between drainage, peatlands, and the long range supply of water.

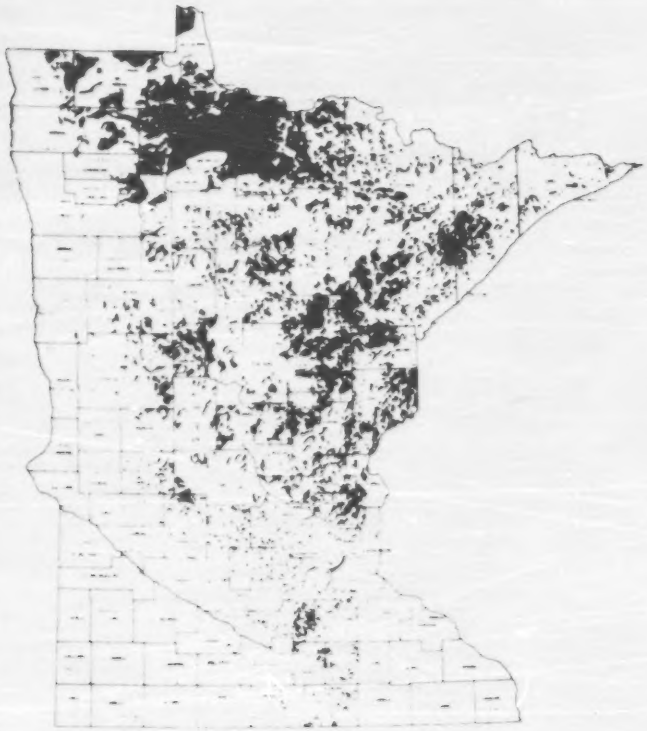


Figure 1. Peat resources of Minnesota: general distribution. (Department of Natural Resources, November 1975)

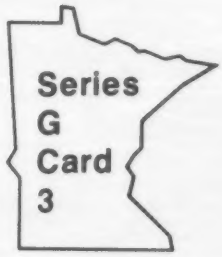
Figure 2. Major peat deposits of Minnesota. (Minnesota Energy Agency, January 1976)

A MINNESOTA ENERGY ACTIVITY
(Information card to accompany Card 2 of Series G)

A Minnesota Energy Activity

Organizing Principle For Series G: The energy situation will affect the future.

Unit 3 Concept: Alternative energy sources continue to be developed.



How do we tell the difference between fact and opinion?

The Big Idea

Objective: To recognize various sources of energy that may play a more important role in the future.

Skills: Gathering and analyzing data, communicating, evaluating.

Materials: Newspapers, magazines, oil and gas company advertising to be used as research sources.

Divide into three groups. Groups one and two are to take opposing sides of a specific energy issue. Each group gathers all the facts it can and adds opinions that will help persuade others to accept the group's position. (Take about a week to gather information.) Groups one and two then make presentations to group three.

The members of group three must make a choice to join one of the other two groups.

Which group has the most persuasive arguments? (Try to figure out whether fact or opinion was the deciding factor in the decision making.)

How do we tell the difference between fact and opinion in matters that relate to energy?

Other Learning Activities

Read "Where Else Will Energy Come From?" on the Information Card included with this series. Then do additional research so you can create a series of posters that illustrate and describe alternative sources of energy.

Gather articles about alternative energy sources from magazines and newspapers. Display them on a bulletin board. After about one month, study the articles to determine what, if any, conflict of opinion there is.

For the Teacher

The photograph and question on the front of this card are meant to stimulate thought about lesser-known energy sources and to interest students in carrying through the learning activities.

The debate over a specific energy issue will help make the students aware of the complexities of the situation. They will see that there are many perplexing questions and no easy answers.

If the students make the posters suggested under OTHER LEARNING ACTIVITIES, arrange to display them somewhere in the school. They will serve as a reminder that we must face our energy problems with ingenuity and creativity. The posters could also be bound and used in the energy resource center in your school or community.

Experiments with alternative energy sources are taking place throughout Minnesota. You might be able to locate a speaker on the subject or go on a field trip that will give insights into our state's energy future.

In articles about alternative energy experiments, you might find some mention of "perpetual motion machines." Although there is no such machine, people continue to be swindled by those who make it appear plausible. Students who are interested in scientific hoaxes should check for books about them in the library.

INFORMATION CARD

WHERE ELSE WILL ENERGY COME FROM?

Sun, wind, wood, water, and peat are sure to be sources of energy in the future. But there are other sources that also have potential.

Gasohol is a mixture of 90% gasoline and 10% alcohol. The alcohol used in gasohol can be made from grain. Minnesota farmers are interested in producing alcohol as a fuel to be mixed with gasoline or used alone. Alcohol could become especially useful as a fuel used to dry grain and power farm equipment.

Two other potential energy sources found on the farm are *animal wastes* and *field residue*. Manure can be used to make methane gas. Field residue such as corncobs and stalks can be gathered and burned to provide heat needed to generate electricity.

Energy will come from trees, but other *biomass (plant)* production may also be important. For example, cattails produce a substantial amount of dry matter that has a high energy content. They can be grown on land that is unsuitable for other crops.

Minnesota, like every other state, has a lot of garbage and trash which is called *solid waste*. There are about 2 million tons of solid waste just in the 7 counties around St. Paul and Minneapolis. Much of this waste could be burned instead of buried. Through pyrolysis—a process in which material is heated in an oxygen-free atmosphere—solid waste can be used to produce oil and useful gaseous products.

The *solar cell* is a device that converts sunlight directly into electricity. The solar cell has no moving parts and creates no pollution. Wires lead from extremely thin silicone cells to electrical batteries which can power lights and motor driven appliances. Solar cells were first used widely in the space program.

Oil shale is a rock which contains a material that yields oil when it is crushed and heated. The rock must first be mined. Then large amounts of water are needed for the extraction process.

Nuclear power is with us today. It is created by the splitting of atoms of uranium through a process called *nuclear fission*. The power is captured and used to create steam which, in turn, is used to produce electricity. *Nuclear fusion* is the joining (fusing) of lighter atoms to form a heavier atom. In the process, energy is released. The energy of the hydrogen bomb comes from the fusion process. Scientists are working on ways to control fusion reactions so that they might be put to use in meeting future energy needs.

The day may come when a *solar satellite* power station is built in space. Possibly a microbeam will carry the energy to earth.

Alternative sources require time and money for development. Meanwhile, we must make our existing supplies last until we have the technology necessary to develop new resources and put them to use. Whatever the alternative source of energy, there is always this big consideration: What affect will it have on the environment?

A MINNESOTA ENERGY ACTIVITY
(Information card to accompany
Card 3 of Series G)

A Minnesota Energy Activity

Organizing Principle For Series G: The energy situation will affect the future.

Unit 4 Concept: Alternative energy sources continue to be developed.

What is there in water that will burn?

The Big Idea

Objective: To discover that hydrogen is a potential source of energy.

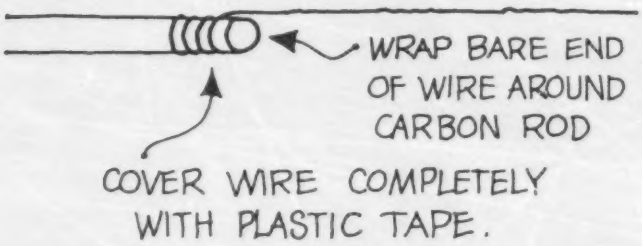
Skills: Designing an experiment, observing.

Materials (This experiment should never be tried without a teacher present.): 2 test tubes, 2 paper clips, glass, lantern battery, bell wire (available in hardware stores), electrician's tape, baking soda, knife, water, broomstraw, matches, carbon rod from a used "D" cell (or the core from a wooden pencil).

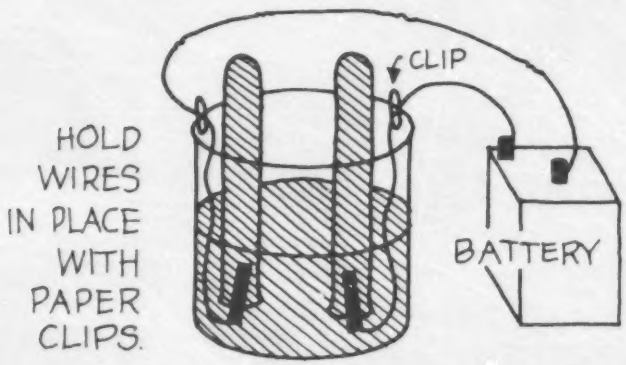
Water is called H_20 because it has two parts H (hydrogen) to every one part of O (oxygen). We can split water into these two elements by using electrical energy. The teacher who demonstrates this experiment must wear safety goggles in accordance with state law.

1. Cut two pieces of wire about 45 cm (18") long. Remove insulation from both ends of both wires.

2. Break a carbon rod in half and fasten a wire to each piece.



3. Add 15 ml (1 tablespoon) of baking soda to ¾ths of a glass of water. Fill the test tubes with the solution and set the experiment up like this. (The *last* thing you do is connect the battery.)



4. In about five minutes, disconnect the battery. Carefully remove the test tubes. *Be sure* to keep your thumb over the mouth of the tube to keep gas from escaping. The tube with the most gas should contain hydrogen. (Do you know why?)

5. The tube with the least gas should contain oxygen. (Do you know why?) Light a broomstraw, blow it out, then stick the glowing end of the straw into the test tube. What happens? Why?

6. Keep your thumb over the top of the second test tube and keep the tube upside down. Light a match and hold it near the mouth of the tube as you remove your thumb. The "popping" sound is hydrogen burning.

There's a lot of water, so why don't we use electrolysis to get out the hydrogen for fuel?

Other Learning Activities

Read about the dirigible "Hindenberg" to find out more about the use of hydrogen.

For the Teacher

The photograph and question on the front of this card are meant to stimulate thought about hydrogen as a potential source of energy and to interest students in carrying through the learning activities.

In the outlined experiment, an electric current separates water into oxygen and hydrogen. When mixed with oxygen, hydrogen produces heat and makes a good fuel. Reaction between liquid hydrogen and liquid oxygen powered NASA* rockets. Hydrogen is expensive to extract and dangerous to handle in quantity. Compared with natural gas of equal volume, hydrogen has only about one-half the energy content.

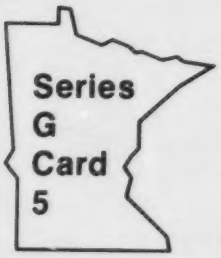
There is speculation that solar energy could be stored by converting it to electricity and then by using that electricity to obtain hydrogen. Hydrogen produced in this matter might fuel internal combustion engines.

*National Aeronautics and Space Administration

A Minnesota Energy Activity

Organizing Principle For Series G: The energy situation will affect the future.

Unit 5 Concept: By making use of wastes, we conserve energy.



What will the earth recycle?

The Big Idea

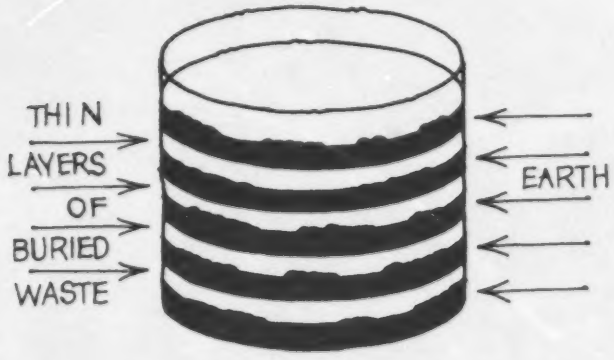
Objective: To discover that the earth recycles some kinds of waste.

Skills: Designing an experiment, classifying, observing.

Materials: (This is at least a month-long project.) Large, clear glass container (aquarium, gallon-size jar) or several wide-mouth jars, dirt and/or sterilized potting soil, plastic wrap or piece of glass to cover container, organic and inorganic materials (bottle caps, paper, lettuce, apple core, bread slice, nails, foil, glass, leaves), water, pencils, paper.

Bury things to find out what the earth will recycle. Have a system to keep track of what happens.

1. Put a layer of dirt or soil in the bottom of a glass container. (Compare results using potting soil and regular earth.)
2. Add waste materials in a thin layer. Cover each layer with dirt. If you use several jars, you may want to put only one or two kinds of waste in each. (Will you want to list and describe the condition of what you bury?)
3. When the jar is full, dampen the contents. (Don't soak.)
4. Cover the jar with a piece of glass or plastic wrap. (There may be some smell!)
5. Place the jar where it can be observed. From time to time, moisten with water.
6. After a month, or longer, empty the contents on newspaper or plastic sheeting. Locate all the materials you put in.



7. Make a chart that shows the results.

   How do the waste materials now appear?

   How do materials put in sterilized soil and regular soil compare?

Other Learning Activities

Diagram the flow of garbage from a garbage disposal.

   How does such disposal increase the use of energy?

   How do wilderness campers dispose of garbage?

Learn about composting. How might a compost pile benefit your family?

For the Teacher

The photograph and question on the front of this card are meant to stimulate thought about what the earth recycles and to interest students in carrying through the learning activities

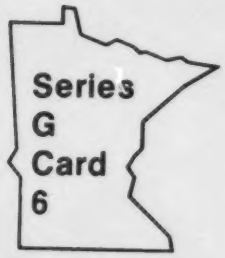
It has long been known that the earth will serve as a recycling system and that organic wastes can be used to enrich and improve the soil. Still millions of cubic yards of organic and inorganic materials are dumped or buried together with little or no concern about the consequences. Although in recent years we have begun to cooperate with the earth, we do so on a rather limited scale.

An encouraging note is that garbage-to-energy programs are being tried. In St. Louis, a test conducted over three years showed that enough electrical power for 25,000 homes was generated by burning a mixture of garbage and coal. By 1984 Connecticut expects to process 85% of its garbage and produce 11% of its electricity from a garbage-to-energy system. But it will take many more such projects and much more thought before we successfully dispose of our wastes by using instead of abusing the earth.

A Minnesota Energy Activity

Organizing Principle For Series G: The energy situation will affect the future.

Unit 6 Concept: By making use of wastes, we conserve energy.



 What use can be made of throwaway things?

The Big Idea

Objective: To create something useful from a throwaway.

Skills: Divergent thinking.

Materials: Glue, scissors, string, and an assortment of throwaway items.

What could you create from something that would otherwise be thrown away? Use your imagination to think of materials to use and what you might make from them.

What could you do with an egg carton? A plastic bleach bottle? An old sock? A cardboard box?

Have a "Creations from Throwaways" contest. When drawing up your rules, decide if you will allow the use of new things such as glue, other fastening materials, and paint. Also decide who will judge the entries and how they will be judged. You might use categories such as most unusual, most useful, best toy, best mask, etc.

How does this activity relate to energy conservation?

Other Learning Activities

Create art objects from paper-mache.

Prepare a report on an artist who is known for collages or on a sculptor who creates works of art from scrap.

Develop an advertising campaign that encourages people to separate their trash for recycling.

Find out what your local government is or is not doing to make better use of wastes.

Write a letter to an editor or a city official suggesting a specific change that could be made in your community to cut down on waste and thus save energy.

For the Teacher

The photograph and question on the front of this card are meant to stimulate thought about how energy might be conserved through finding new uses for what would otherwise be discarded and to interest students in carrying through the learning activities.

This activity is intended to help children think about discards and ways to put them to creative use. Could the plastic bottle become a scoop? A piggy bank? What else? How could an egg carton become a toy? Turning a discard into something useful is a concrete way of putting the conservation ethic into practice.

Many of the products we use every day require fossil fuels in their manufacture. Often fossil fuels make up at least part of the raw materials from which the product itself is made. Nylon and other synthetic fibers are made from petrochemicals. So, too, are plastic products. By using products of all kinds over again—whether through recycling or finding new uses for them—we save energy.

A Minnesota Energy Activity

Organizing Principle For Series G: The energy situation will affect the future.

Unit 7 Concept: The energy situation has an international impact.

The Big Idea

Objective: To understand that having energy resources gives a country economic and political power.

Skills: Gathering and analyzing data, communicating.

Materials: Globe or world map.

When oil producers around the world come together for a meeting, decisions that they make have a far-reaching effect. Why? (Because the price of oil is set at such meetings.)

Find out what countries we buy most of our oil from. Locate them on a globe or world map. Learn about the various countries. Are they large or small? Industrialized? What is the population? What do the countries need to import? What resources other than oil do they have?

Hold a meeting of oil producers to decide what to do about the price of oil for the coming year.

- Why might one country consider it important to double the price?
- Why might another argue to hold the line on prices?
- What could make a country want to stop selling oil to a certain country?
- Why does having an abundance of oil give a nation economic and political power?

Other Learning Activities

Gather all the facts you can about present energy consumption, production, and known reserves. What countries might have special economic and political power if coal becomes as important to the world as oil is today? Make graphs with the information that is gathered.

Develop a game in which players represent various world countries competing to buy oil. Have each country require 10% more oil per year while the amount of oil available remains constant.

Who will get the oil? Why?

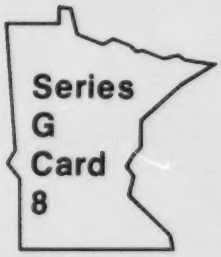
For the Teacher

The photograph and question on the front of this card are meant to stimulate thought about why and how energy resources give a country economic and political power and to interest students in carrying through the learning activities.

The heavily industrialized nations of the world have become so dependent on petroleum that any change in supply, demand, or price affects all of us. The world runs on oil. Without it, countries such as Japan—which has to import all its oil—would see the collapse of its economy. Although the U.S. also depends heavily upon foreign oil, we do have resources to meet some of our needs. We could not, however, maintain our present standard of living without importing oil.

Oil producing nations have great economic and political power because they have a product which is in ever-increasing demand. Although some new oil fields will be discovered, it is unlikely that the rate of discovery will meet the rate of consumption. Naturally, the oil producing nations want to get the most they can for this valuable, non-renewable commodity. Watch the newspapers and magazines for relevant articles to add to your energy bulletin board or interest center.

A Minnesota Energy Activity



Organizing Principle For Series G: The energy situation will affect the future.

Unit 8 Concept: The energy situation has an international impact.

If there's not enough for everyone, who gets what there is?

The Big Idea

Objective: To be aware that energy rationing is a future possibility.

Skills: Communicating, problem-solving, divergent thinking.

Materials: Treats such as individually wrapped candies or pieces of gum (both preferably sugarless) for *one-half* of the class.

When there is a limited supply and a great demand for something, how can the supply be distributed fairly? Use the democractic process to work out a plan to distribute treats to the class when there are only enough for one-half of the members.

After you have carried out your plan, discuss the difficulties of rationing.

- Were all the class members satisfied with the way the treats were divided?
- If you were dividing the treats again, would you revise your plan? How?
- What if there were only going to be half enough treats for the class every day? How would that change your rationing plan?

Other Learning Activities

Invite someone who remembers the rationing during World War II to visit your classroom. Ask the person to discuss what was rationed and the impact it had on life.

Over 40% of Minnesota's electricity comes from nuclear power. Pretend that all nuclear power plants are closed down for one month.

- What would we do to cut back on at least one-half of our use of electricity at home? At school? What would happen if we did not cut back our use?

For the Teacher

The photograph and question on the front of this card are meant to stimulate thought about rationing as a means of distributing energy and to interest students in carrying through the learning activities.

The steadily rising cost of energy has already had a serious impact on the people of Minnesota. Following the oil embargo of 1973, price became an economic form of rationing. Many Minnesotans—especially the poor and those on fixed incomes—were forced to either limit their use of energy or to cut back on other spending to meet increased energy costs. Winter heating bills are a continuing problem for many Minnesota residents.

Rationing through price is unfair because it is most hurtful to those least able to pay. But no matter what form rationing takes, it is unpopular and creates such problems as hoarding, theft, and black marketing.

Conservation should be discussed in relation to the activities suggested on this card. Whether rationing does or doesn't become a part of our future depends to a large extent on our country's efforts at voluntary conservation.

A Minnesota Energy Activity

Organizing Principle For Series G: The energy situation will affect the future.

Unit 9 Concept: Further advances in energy-related technology will have an impact on our lives that is difficult to imagine.

Series G Card 9

In what ways is energy being used for transportation?

The Big Idea

Objective: To construct a time-line that shows the development in modes of transportation.

Skills: Observing, communicating, classifying.

Materials: Long piece of wrapping paper, tape, magazines, crayons, construction paper.

What form of transportation did the voyageurs use? When was the first letter carried on an airplane? What is a rocket's source of energy? Who invented the escalator? How many snowmobiles are there?

Use a long piece of paper to construct a time-line that includes all the means of transportation you can think of. Also indicate the source of energy for each. To illustrate your work, use magazine pictures and your own drawings or sketches. The time-line should be a help in understanding that our means of transportation have changed because of such things as the invention of the steam engine, the discovery of petroleum, and the harnessing of nuclear energy.

Other Learning Activities

Write a science fiction story about a character who uses a form of transportation that is not yet in use.

Invite a futurist to come to your classroom to speak.

Use cardboard boxes as containers in which to construct dioramas depicting transportation in 1885, 1985, 2085.

For the Teacher

The photograph and question on the front of this card are meant to stimulate thought about developments in the means of transportation and to interest students in carrying through the learning activities.

Will technology be the answer to our energy situation? Pessimistic observers believe we've squandered our energy resources and face a bleak future. Those who put their faith in technology are optimistic. They see many potential solutions to today's energy problems.

In working with the learning activities on this card, one thing becomes clear—we are a people who invent and then refine what we have done. The bulky, wooden dugout has become a sleek, fiberglass canoe. The Wright brothers' flimsy airplane that barely lifted off the ground was the forerunner of jumbo jets that transport hundreds of people. The sputtering first automobile has evolved into a sports car that can travel at speeds in excess of 140 miles per hour. Although the evolution in car design continues, the direction today is toward greater efficiency rather than higher speed.

By indicating on the time-line the fuel used to operate the various means of transportation, we see how heavily we depend on fossil fuels for our mobility. You may want to discuss how different life would be if cars had not been developed, if we had only mass transit, or if all transportation systems ran underground.

A Minnesota Energy Activity

Series G Card 10

Organizing Principle For Series G: The energy situation will affect the future.

Unit 10 Concept: Further advances in energy-related technology will have an impact on our lives that is difficult to imagine.

What may happen as fossil fuels become more scarce?

The Big Idea

Objective: To speculate about life in a time when fossil fuels become less accessible.

Skills: Gathering and analyzing data, evaluating, communicating.

Materials: Newspapers, news magazines, construction paper, pencils, crayons.

It's difficult to measure how much oil, coal, and natural gas there is underground. So no one can tell when we will run out of these fossil fuels. Although experts disagree on the amount of nonrenewable fuels, we have to realize that planet earth is like a huge spaceship carrying a fixed amount of fuel.

Gather news clippings that relate to today's energy situation. Develop a way to evaluate the stories in terms of how optimistic or pessimistic they are. Then paste them into a collage or an energy scrapbook.

What conclusions can you draw from your evaluations?

Other Learning Activities

Draw "Rube Goldberg machines" that are meant to solve specific energy problems that have been mentioned in the news.

Who has "sun rights"? Divide into three groups: the Judge Group, the Home Owner Group, and the Want-to-Build Group. The Home Owner Group lives in solar heated houses on a hillside. The Want-to-Build Group has just bought expensive land on which to build a condominium. This 20-story building will cast a shadow over the Home Owner Group's solar collectors during the brightest hours of the day. The home owners don't want the new building. So both groups must present their arguments to the Judge Group which must decide who has "sun rights."

For the Teacher

The photograph and question on the front of this card are meant to stimulate thought about life in a time without fossil fuels and to interest students in carrying through the learning activities.

It's apparent that there are no simple solutions to the energy situation. We are, however, a problem-solving people who take on challenges that range from cleaning up the environment to putting an astronaut on the moon. Such determination and ingenuity must now be turned to meeting our energy needs.

Throughout history, one energy source has become less important as a more efficient one was discovered or developed. Human muscle power gave way to animal power. To meet the needs of an industrialized society, wood was replaced by coal. Coal, in turn, was largely replaced by oil and natural gas. Now that these nonrenewable sources are dwindling (although there is a lot of coal), we look to conservation, new sources, and new technology.

Meeting energy needs will be a continuing and critical issue for all of us. By encouraging children to become knowledgeable about the nature of energy, its uses, and related problems, we increase interest in the conservation ethic. Cutting back on our energy consumption is the one step each of us can take to extend the life of our remaining fossil fuels.